The Foundry Trade Journal

AND

PATTERN-MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

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BRITISH FOUNDRYMEN'S ASSOCIATION.

MR. F. W. FINCH, the Honorary Secretary of the British Foundrymen's Association, has issued the following annual report to the members:—

In presenting the first annual report and balance-sheet to the members, it is a pleasure to be able to report the steady growth of the Association since its commencement with seven members in April, 1904—we have now, at the end of the year, a large membership. The first Convention was held at Owen's College, Manchester, on Tuesday, August 2nd, with 50 members present. It was a most successful gathering, and every member present felt well repaid for the trouble he had taken to attend the Convention. Since the Convention I have sent out 1,000 more circulars addressed to foundry managers, foundry foremen, and foremen pattern-makers, with very fair results.

There has been a good deal of correspondence between the new proprietors of the FOUNDRY TRADE JOURNAL and myself with the view of appointing the Journal as the official organ of the Association. The whole correspondence was submitted to your committee on Saturday, December 3rd, when the following resolution was unanimously passed:—

> Moved:—"That we agree to notify our members that the FOUNDRY TRADE JOURNAL be recognised as the official organ of the Association, and also that in it will be found monthly matters relating to the work of the Association, and recommend members to become subscribers. The committee undertake to supply matter monthly relating to the work of the Association. The proprietors of the FOUNDRY TRADE JOURNAL, on their part, undertake to supply the Journal to members subscribing thereto at the reduced rate of 5s. per annum."

And the Committee specially recommend members to subscribe for and support the Journal. The advantage to the members

will be that they will be kept in touch with all that is going on within the Association, as notifications, reports, and all items of interest relating to the Association will be published monthly (space being reserved for this purpose), the proprietors of the Journal having agreed to our resolution.

At the same meeting a letter was read from Dr. Moldenke, Secretary of the American Foundrymen's Association, which shows the apathy of employers in the foundry business in that country—and which, I am sorry to say, is also the same in this country, and also showing that—per ratio to the number of foundries in the two countries—we had passed the American Association, and it is a pleasure to note the good feeling generally existing between the two Associations.

In this connection the following extract from a letter received from the Secretary of the American Foundrymen's Association is of interest:—

"I want to thank you very much for your valued letter of the 26th ult., and the 'Transactions' of your Association, which I have read with much interest. You are doing nobly, and have every reason to congratulate yourself on what you have accomplished. You will find, as we do, that the very men who will not contribute a cent are the ones who write you for advice and absorb your published reports, getting all they can from them. There are exceptions, and these exceptions you will enrol among your membership in the near future.

The following letter was also read from Dr. Bone, lecturer in fuel and metallurgy at the Manchester University. It was considered by your committee to be of such importance that it was decided to publish the letter in full:—

"DEAR MR. STEWART,—

"I much regret that my holiday arrangements prevent my accepting your kind invitation to attend the inaugural meeting of the British Foundrymen's Association. The objects of the Association seem wholly admirable, and I am glad to note that the committee, in the circular convening the meeting, emphasise the importance of 'an interchange of ideas, and of scientific and practical knowledge.'

"I cannot lay claim to any practical knowledge of foundry work, but as the circular speaks of an 'indifference to scientific fact and higher knowledge which has too long beset us,' I take it that a need is felt for an Association which shall promote the application of more scientific methods in foundry practice.

"This is so far very good, but if the new movement is to be completely successful, there must be something more than the mere reading and discussing of papers on the day of the annual meeting. Of the reading of papers there is no end, and technical discussions frequently produce more heat than light. Some basis should be provided for the co-operation of the practical man and the scientific worker during the remaining 364 days of the year. At the annual meeting problems of general interest to the trade should be selected, and arrangements should be made for their systematic investigation on practical and scientific lines. The reports of such investigations would in due course be discussed at subsequent meeting and circulated among the members of the Association. I venture to think that it is only by the organisation of research on some such lines as these that the best results can be achieved.

"The essential condition for the success of such an idea is that the scientific worker

Photo by [*T. McFarlane.*

BRITISH FOUNDRYMEN'S ASSOCIATION AT WORKS OF MESSRS. CRAVEN BROS., LTD., REDDITCH.—ANNUAL MEETING, 1904.

on the one hand, shall allow himself to be guided by the judgment of the practical man in the selection of the particular problems to be attacked and in carrying out the work as far as possible on practical lines. On the other hand, the practical man must be prepared to take the scientific worker completely into his confidence, and to withhold from him no information, even when so-called 'trade secrets' are concerned, which may be material to the subject under investigation. In a word, the bogie of 'trade secrets,' at present the great obstacle to progress, should be laid under the table and kept there. If the members of the new Association are prepared to adopt a vigorous and progressive policy I have every confidence that a large measure of success will be achieved.

"Believe me,

"Yours faithfully,

"WILLIAM A. BONE."

I have endeavoured to arrange a meeting of employers, managers, foremen and others engaged in the foundry business at Glasgow, when your President volunteered to read a paper on "Foundry Practice," but am sorry to say that it has fallen through for the present.

Our President lectured on Saturday, January 14th, at the Municipal Technical Schools, Birmingham, on the "Principles and Practice of Core Making." He is also lecturing in Coventry some time in February.

An invitation has been received from the Bristol and District Employers' Association to send a deputation to one of their meetings and to read a paper. Your Secretary has promised to attend and explain the objects of the Association, and also to read a paper if time will permit.

I am now endeavouring to form our members into districts—and am pleased to say that the Manchester district is getting into order—when papers will be read and discussed and also published for the benefit of other districts. Birmingham district is following on the same lines, and I confidently appeal to foundry employers to assist us financially, so that the committee can carry on the good work of educating those employed in the foundry trade, for whatever is gained by the workman will be to the advantage of the employer.

In conclusion, having enrolled one hundred members during the first year of our existence, I would make a special appeal to every member of the Association to try and get one new member each, so that we could meet at our next Convention in 1905 with a still larger membership. The following places have been suggested for the meeting, viz., Glasgow, London, and Birmingham, and I should like to hear from every member giving a vote upon the three places and also suggesting a date for the holding of our next Convention. Glasgow has the advantage of being at work during August Bank Holiday.

The balance sheet is as follows:—

FIRST ANNUAL BALANCE SHEET.

INCOME.

	£	s.	d.
100 Members at 7/6 each	37	10	0
Engineering Magazine	0	2	0
Total	£37	12	0

EXPENDITURE.

Postage	8	0	4
Stationery	1	3	4
Telegrams	0	3	2
Foreign Postage	0	8	9
Clerical Assistance	2	4	11½
Printing	3	2	6
Expenses of Convention	3	16	0
,, Committee	2	2	0
Secretary's Expenses	1	18	3
Printing of Proceeding	11	3	0
Sundries	0	1	9
	£33	19	0½
Balance in hand	3	12	11½
Total	£37	12	0

The officers of the Association are now as follows:—President, Mr. Robert Buchanan; Vice-President, Mr. H. Pilkington; Members of Council: Mr. C. Morehead, Mr. F. C. Shaw, Mr. Percy Longmuir, Mr. W. Vickers, Mr. J. Ellis, Mr. J. Thomson, Mr. J. G. Stewart, Mr. F. J. Cook, Mr. W. Roxburgh, Mr. T. McFarlane, Mr. R. Mason, Mr. W. F. Bagnall; Hon. Secretary, Mr. F. W. Finch.

—o—

FRENCH FOUNDRY PRACTICE.—At a recent meeting of the Leeds University Engineering Society Mr. G. H. Attock brought forward the subject of French foundry practice. He stated that while English foundry masters more than held their own with regard to heavy castings, France and Germany excel in the production of small or intricate castings. This is especially noticeable in work for the motor-car and motor-cycle trades. The predominance is due to the extensive and intelligent use of moulding machines in foreign foundries. He had seen in France twice as many pieces turned out per hour from a moulding machine, worked by a labourer, as an English moulder could turn out per day. This superiority is entirely to the credit of the machine, as the average English moulder is a better workman than the average French moulder.

TRAVELLING BLOCKS AND HOISTS.

THE automatic transport of material to a distance by overhead trolley conveying apparatus is rapidly increasing in foundries, and this is not a matter of surprise when we remember how many places

FIG. 1.—CENTRE-BEARING TROLLEY : TELPHERAGE SYSTEM OF MESSRS. SIEMENS BROS.

there are where the installation of an overhead system would prove an economical investment. In these days of large companies, factories cover immense areas. The individual buildings are frequently large enough in themselves to utilise an overhead line. In many cases, on account of the fire risks, or of convenience in manufacturing, these buildings are widely separated from one another, and yet constant communication is necessary. The overhead line is, therefore, used for :—

1. Carrying the raw material, implements, and the finished product from
   (*a*) One part of the grounds to another.
   (*b*) One building to another.
   (*c*) One part of a building to another.
2. Carrying raw material from the trucks to the works, and then taking the finished product to the railway station or the wharf for shipment.
3. Carrying refuse away from the factory.
4. Sending letters, orders, directions, blue prints, etc., from the office to various parts of the works.

Some of the advantages of the overhead trolley for the above-named purposes are :—

1. Loads can be deposited just where they are needed, much re-handling being avoided.
2. Loads can at any moment be sent wherever they are desired without the delay and inconvenience necessitated by the use of wagons or trucks.
3. Great economy of time and labour is made possible, with a consequent decrease in the running expenses and increase in the amount of production.
4. Skill and experience are not necessary in the operation of the line.
5. No floor space is needed.
6. Since the line is overhead, there is no danger of collision with employés.

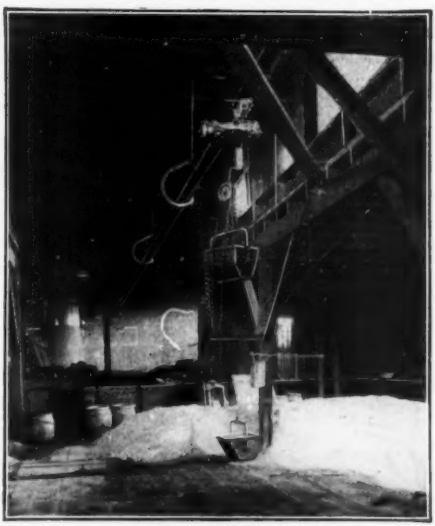

FIG. 2.—CENTRE-BEARING TROLLEY : TELPHERAGE SYSTEM OF MESSRS. SIEMENS BROS.

Moreover, piles of machinery, roadways, etc., do not interfere with the working of the line.

7. The line is neat and attractive in appearance.
8. The cost of operation is very small, and is proportional to the amount of work to be done.

9. The line is constructed with such strength and simplicity that there is seldom any necessity for repairs.

10. The system is exceedingly flexible.

(*a*) It is prepared to meet special conditions with the installation of every line.

(*b*) A single line can be adapted to the carrying of loads of widely varying kinds and weights.

(*c*) Curves, inclines, and inequalities of level are no obstacle, although, of course, the cost of installation is less when the line is straight, and runs level.

(*d*) At the will of the operator at the starting point, the trolley can stop automatically at any point along the line; and also automatically lessen its speed in going around curves, down grades, and in approaching the stopping point.

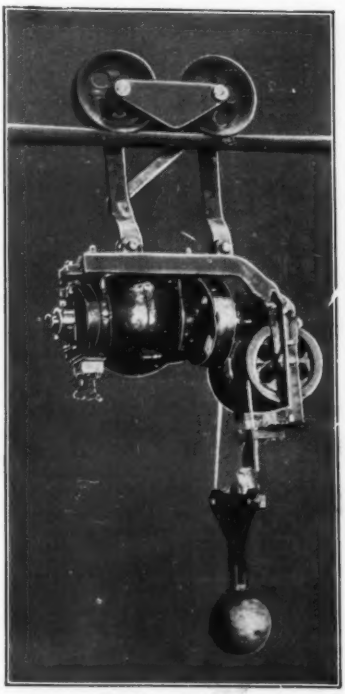

FIG. 3.—SIDE-BEARING TROLLEY; TELPHERAGE SYSTEM OF MESSRS. SIEMENS BROS.

The above advantages are not realised in all overhead trolleys, of which there are several types on the market. These vary from the hand hoist of the simplest kind —which might, and frequently is, built and put up by any fitter or "handy man" —to electric systems of considerable proportions. Compressed air systems have also been introduced.

In addition to the ordinary run of foundry work, in which the applications of trolleys are very numerous, the handling of coal and ashes in and from the boiler rooms has always involved considerable cost, necessitating in many power houses the employment of one or more additional men to those actually engaged in the firing of the boiler furnaces for this work alone. In most of the largest power houses very

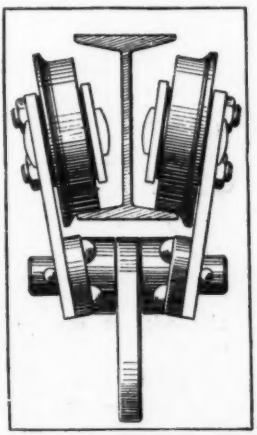

FIG. 5.—FOUR-WHEEL PLAIN TROLLEY: CROSS VIEW.

FIG. 6.—WILLCOX TROLLEY.

elaborate systems of coal handling are used, and in every case have proved a great source of economy, paying for themselves in a few years. In these days of labour-saving devices, no engineer would think of designing a power house of any considerable size without one or another mechanical system of automatically handling the necessary coal and ashes.

Tracks for overhead trolleys may be made either of cable—made of standard wire or lock coil type, which latter has a strength approximating 95 per cent. that of the solid bar—or else solid rail, either of flat, girder, or bulb type. For foundry work the solid rail is preferable and, indeed, almost universal.

If a cable is used, the tracks are supported at convenient intervals. In addition to the track cable, upon which the trolley runs, there is also what is known as the suspension cable. As is well known, it would be impossible to prevent a considerable sag in the track cable, and therefore the track cable is suspended from this suspension cable by means of hangers. The number of these hangers depends upon the length of the spans. Cable construction costs less than solid rail, except where there are many switches, in which cases the price of solid rail and cable approach each other. The aerial ropeway to a certain extent is in a different class of mechanical appliances, and in this article it is proposed to mainly deal with trolley conveyors designed to work on solid rails.

The only system in which a rope is used as a track, to which we will refer,

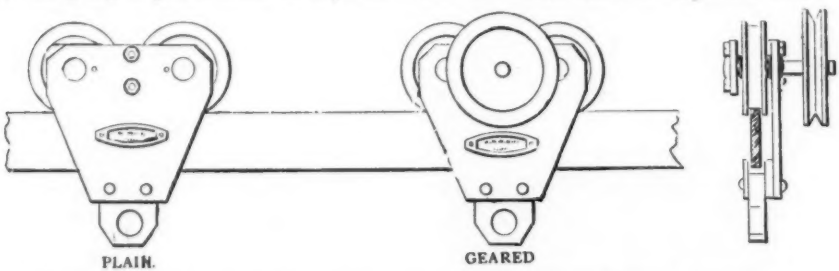

FIG. 4.—A SIMPLE FORM OF TROLLEY CONVEYOR: BROWN HOISTING MACHINERY COMPANY.

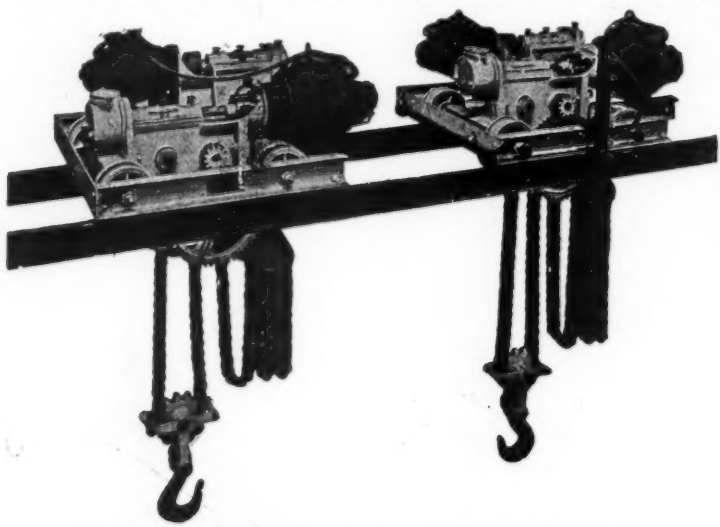

FIG. 7.—DOUBLE TRUCK TROLLEY: BY THE BENRATH ENGINEERING COMPANY.

is that of Messrs. Siemens Bros. & Company. In this, two types of trolleys are adopted—centre bearing and side bearing. The centre bearing has two motors, one on each side of the track, while the side bearing has both motors on the same side. Illustrations of each kind (Figs. 1, 2, and 3) are shown, also the same in operation.

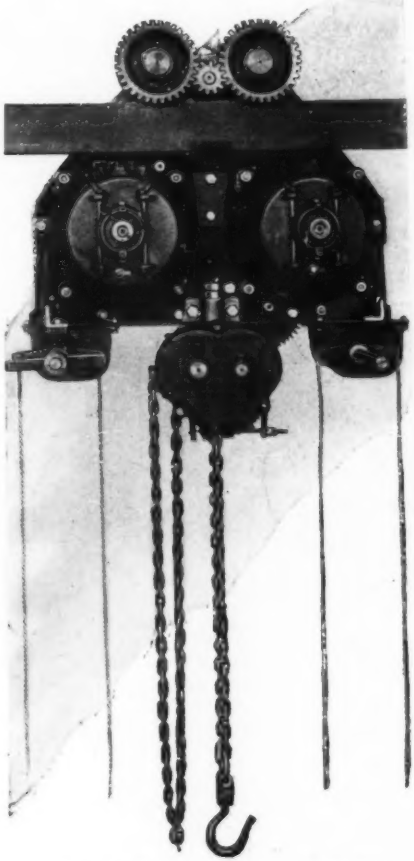

FIG. 8.—ELECTRIC TRAVELLING BLOCK: SPRAGUE TYPE.

All the weight in the side-bearing trolley is utilised for traction, and the load is suspended beneath the driving wheels. Sometimes two trolleys are connected up together in a single truck, this giving what is called a double trolley, or a trailing wheel is used after a double trolley in order to distribute the weight over a greater portion of the track. This is necessary when the weight of the load to be carried is great.

The motors are waterproof and dust proof, and are compound-wound for automatic work. When a man goes with the trolley the series winding is employed. There is also used a special series coil to give greater torque when starting. The hoist is suspended below the trolley, or sometimes from a trailer drawn by the trolley.

Two distinct types of brakes are used in the United Telpherage Company's system, either hand brakes or solenoid brakes, both of which are arranged to apply pressure to the wheels or to grip the track. In regard to the solenoid brake, it is only necessary to explain that it works automatically, the solenoid being placed in series with the armature. A spring normally holds the brake on the wheel or the track. If, however, from any cause, the amount of current passing through the solenoid is reduced, whether by means of external resistance, or by reason of the additional counter electromotive force generated by the armature, due to running at a high speed, the solenoid becomes weakened, and the brake is applied. An air cushion is arranged so that the brakes will be applied gradually.

It is often advisable, where a large amount of material is to be carried, especially over one track, to use trailers. These consist generally of a two-wheeled truck, below which is suspended a bucket or other suitable form of carrier, or even the hoist, as the case may require. The order of procession is, first, a trolley with four or five trailers, then another trolley and four or five trailers, and a trolley at each end.

In automatic lines it is necessary to provide appliances whereby it is impossible for an unskilled operator to injure the trolley. In order, therefore, to provide for contingencies, a "dead section" in placed at each end of the line, the middle of the line being generally left alive. Upon closing a spring switch, the dead section is energised so long as the operator keeps his hand on the switch, which is generally only a few seconds, during which time the trolley passes to that portion of the line which is always alive. When it reaches the other end, it comes upon the dead section, and then either slows down of its own accord, or else a mechanical or solenoid brake is applied. The trolley then passes under the reversing arrangement, and it is therefore reversed, either with no current in the line or else with a high resistance. If the trolley is at the further end of the line, the operator at the near

end, by closing a switch, can bring it back to him.

The cheapest and simplest form of overhead track is that shown in Fig. 4, which is designed to run on a flat steel bar. These trolleys usually have bronze bearings, and may be plain or geared. The trolley travelling motion for the geared trolley is obtained by a pendant hand chain and sprocket wheel, geared to the trolley truck wheels. A further step is shown in Fig. 5, which illustrates a trolley provided with four truck wheels, each secured to a steel pin revolving in a pair of self-adjusting bronze bearings. The frame is of wrought iron or steel plates, with inner bearing plates securely bolted to the outside plates, giving an inside as well as an outside support to the wheels, which reduces very materially the resistance to motion along the overhead beam. The bearings are almost always self-oiling, and are equipped with proper receptacles for holding a supply of oil. The trolley travel is effected in the "Plain" trolleys by pulling or pushing directly on the load. In the "Geared" trolleys the trolley travel is effected by operating the pendant hand chain, which is geared to the trolley truck wheels.

In solid rail construction, the supports are ordinarily placed 16 to 20 ft. apart; longer spans are used if it is not convenient to erect supports. On long spans, the track consists of a girder rail, with the track rail above it. It is not possible to give any general rule as to what kind of track it is advisable to use, as this is a factor of the length of the spans and the weight. For inside work, the solid rail is the type usually adopted.

Fig. 6 shows the type of rail adopted in the Willcox overhead system.

One of the earliest examples in this country of the electric trolley on a solid rail is one which was erected some seven years ago at the Manchester Victoria Railway Station for the conveyance of passengers' luggage from one platform to another. This was of the type that requires an operator to travel with the block. Since then Messrs. Mather & Platt have erected a number of both the single and double rail type. A standard 15 cwt. block of this firm's make is designed with a travelling speed of 700 ft. per minute and a hoisting speed of 26 ft. per minute. The current taken at starting when lifting this load is about 40 amperes at 100 volts, but this generally decreases as the hoisting proceeds. A trolley made by the Benrather Machine Company, of Victoria Street, is shown in Fig. 7, and is interesting as showing a double track type of construction.

The Sprague type of travelling hoist is shown in Figs. 8 and 9. Fig. 8 shows a side view of the Sprague trolley block. The machine is provided with two enclosed motors, one of which is geared to the hoisting mechanism below, while the other is connected to the traversing wheels above. Both hoisting and traversing gears are provided with electro-mechanical brakes,

Fig 9.—Electric Travelling Hoist Sprague Type.

which are normally set and automatically released when the motors are put in operation. The control of the motors is obtained through the pendant cords or chains shown to the right and left, there being one cord for each direction of motion. They are arranged with automatic limit cut-offs, which shut off the

power when the limits of motion in each direction are reached. These machines are made in capacities up to 800 lbs. the speed of hoisting being about 1 ft. per second for a 500-lb. load. The traversing speed is 6 miles per hour. The hoist takes its power through trolley wires in the ordinary way. In order to obtain quiet operation, the pinions on the motors are of raw hide. The machine requires only 7 in. head room above the track, and very short curves can be turned. Fig. 9 shows a Sprague electric travelling hoist, the construction of which is easily understood from the illustration. The hoist is similar to that shown in Fig. 8. This hoist will lift a load of 4,000 lbs. It is intended that this apparatus shall be put up on tracks of girders 21 in. apart. No provision for traversing is made in it, this movement being accomplished by hand.

Fig. 10 shows an electric trolley block built by the Brown Hoisting Machinery Company, of 39, Victoria Street, S.W., in sizes from 1 to 5 tons. The appliance is suspended from eight wheels, four of which run on each side of the flange of the girder, as shown. The machine is furnished with swivelling trucks, and the 5-ton size will run around a 15-ft. radius curve. An electric motor is provided for each motion of hoisting and travelling, and the operator rides with the block. The current is taken from overhead wires by means of two small under-running trolleys, and the appliance is geared for travelling speeds up to 1,000 ft. per minute and hoisting speeds up to 200 ft. per minute. Fig. 11 shows the type of construction adopted by the Pawling & Harneschfeger Company. Electric power applied to the hoisting drum, while the trolley travel depends on a hand-chain drive.

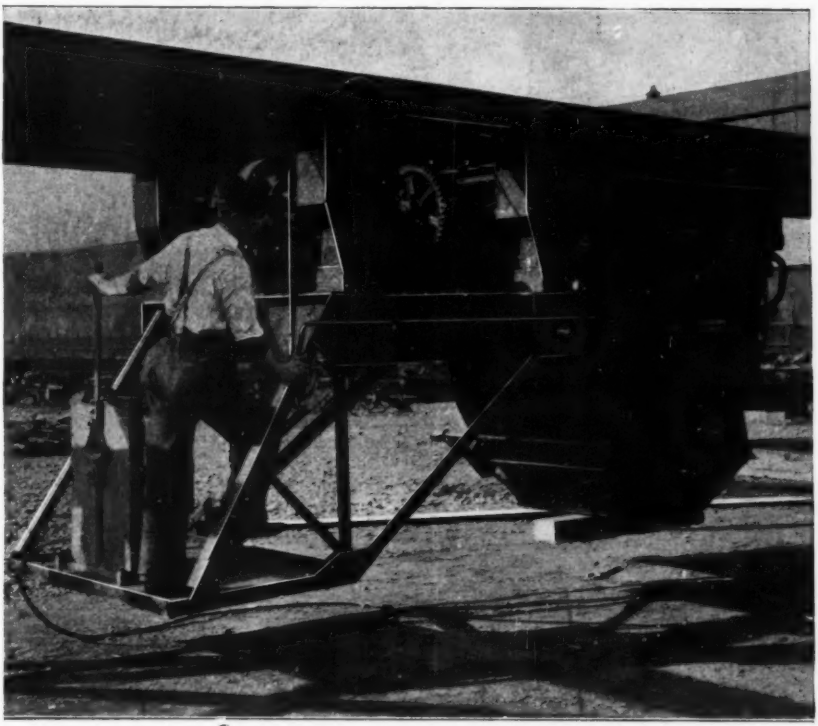

FIG. 10.—ELECTRIC LARRY, WITH SUSPENDED TRACK: BROWN TYPE.

In concluding this article a word may be said as to the relative advantages of a double-railed and a single-railed track In the case of a double-rail being used the trolley usually runs on the top of the rails, which are sometimes supported by

insulators from suitable hangers. In this case the rails serve as conductors for the electric current, one being the lead and the other the return, and the rims of the wheels are insulated from the axles. The current passes from one rail to the rim of the wheel running on it, and is collected from the rim by means of carbon brushes, whence it passes to the motor, returning through the insulated rim of the wheel on the opposite side of the machine to the other rail. In the single rail the current is invariably brought to the motor by bare wires, from which the current is usually collected by trolley arms similar to those used for electric street tramways or their equivalent. The running rail, in this form of construction, does not carry any portion of the current, and there is no necessity for the insulation. Consequently, the track is simpler and less expensive than in the double rail system, apart from the question of using one rail instead of two. As a matter of fact, for lifts up to 1 ton the single track will cost, say, 7s. a foot run, as against 17s. for the insulated double track. The arrangement of the track will differ in each foundry, but as illustrating the system applied to a foundry, Fig. 12 shows an arrangement of Willcox tracks for pouring purposes.

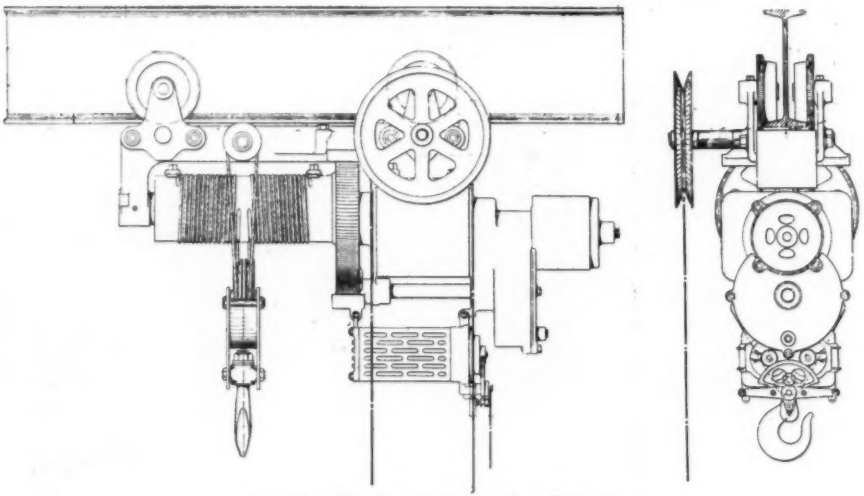

FIG. 11.—HARNESCHFEGER TYPE OF TROLLEY.

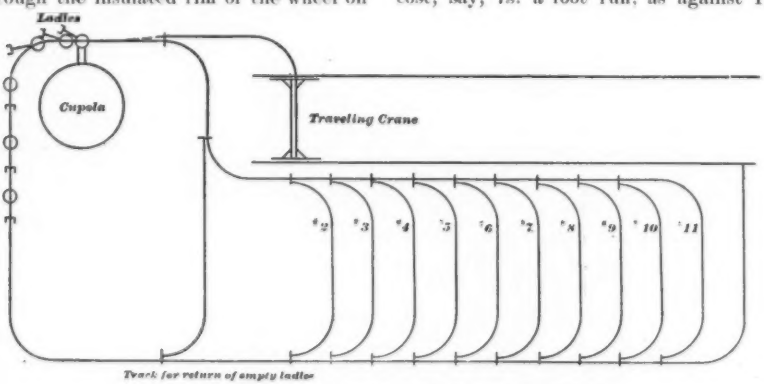

FIG. 12.—WILLCOX TRACKS FOR POURING PURPOSES.

PATTERN-MAKING.*

By R. Watson.

Twenty or thirty years ago pattern-making and millwrighting were considered joint branches of engineering, but gradually, as competition and more complicated work came along, it was found that a man, to become thoroughly efficient, must devote his whole time to one branch. This subdivision has again taken place in the pattern-shop of recent years. Iron pattern-making has become quite a separate section. This includes the fitting up of iron patterns, turnover-plates, and all stripping plates, etc., required for moulding machines. Again, where moulding machines are used, men are kept on the special patterns that are required for them until they become quite experts at this class of work.

It is not the writer's intention to deal with these special kinds of patterns; each are important enough in themselves to form a separate paper, but to confine himself to his actual experience of wood patterns. It may be well to consider the material used in pattern-making. Timber merchants have at various times advised several different kinds of wood, such as kauri-pine, American white wood, teak, and jarrah, etc., but experience has proved that they are not as suitable for pattern-construction as Canadian pine, and the mild straight-grained mahogany of Tabasco and Belize.

Timber for standard patterns should be carefully selected, as there is a considerable variation in the quality of yellow pine. It is not unusual to find a shipment of pine altogether unsuitable for pattern-making. It may be free from shakes and knots, but has the defect of being hard in places, which is known to the pattern-maker as being "strong." Timber of this kind has a great tendency to twist and warp, and, if worked up into patterns, proves costly in repairs, as it will not keep its shape so well as the milder quality. Yellow pine planks should be at least three years old. Weather-seasoned wood invariably works better than that artificially dried. Where large standard patterns are made it is advisable to have good stocks in hand of various thicknesses of a first quality; also a second quality which may be used for temporary patterns, loam-boards, etc. Experience shows that this tends to great economy. It should be carefully stacked and stored so that it is kept out of the sun and rain, allowance for free passage of air being left between each plank.

The circular-saw, band-saw, planing machine, thickness-planer, and lathes are indispensable tools. The hand-trimmer might also be classed amongst them, for it considerably cheapens the production of patterns, especially of that class which are built up in segments. The introduction of pneumatic tools into the pattern-shop are amongst the latest labour-saving devices. Portable drills and chipping-hammers are finding a very useful place on large work; they have this advantage, that they can be brought right on the work during the different stages of construction when it would be impossible to move the work at the different machines. Chipping-hammers fitted with a gouge tool are very handy for removing surplus wood to form curved surfaces in patterns and core-boxes, doing the work from four to six times faster than it is possible with hand tools. Pneumatic drills also dispense with the pattern-maker's brace and bit, and perform the work very rapidly and with considerably less labour to the man.

In large pattern-shops where standard patterns are made, machines such as "The Moore" carving machine or "Wadkins" mechanical wood-worker, can be kept profitably employed in core-box making, recessing to different levels, and in the many different operations which are performed in the making of complicated patterns, these can be done more accurately and quicker than by hand.

It is in the pattern-shop that the engineer and draughtsmen first see the actual thing which they have designed. Many views and sections may be given, but there still remain points which have to be left to the judgment of the pattern-makers, such as the development of curves, rounded edges, fillets, etc., all of which go to make the symmetry of the whole.

Upon receiving a drawing in the pattern-shop, if the work is at all complicated it is set out full size, but in some cases sections only that are required for the construction of the pattern and arrangement of cores. Machining allowances are shown. All the setting out is done to a contraction rule, so that any dimension which may be taken is the pattern size.

In some works the foreman or leading-hand sets the work out. The writer prefers that each pattern-maker should set out his own work; by so doing he makes himself familiar with all the details. He is then in a position to discuss the construction of the pattern, method of moulding, and arrangement of cores. It is usual for the principal dimensions to be

* Paper read before the Rugby Engineering Society.

checked by the foreman. The first thing that has to be determined is the best way of moulding, and if it is likely to be a permanent or temporary pattern. The chief things that govern the moulding are the principal machined surfaces; these are placed in the bottom of the mould to ensure them being clean and free from defects. If it has to be machined all over, or top and bottom, extra machining should be allowed on the top side. This should be plainly marked on the pattern before being sent into the foundry by different coloured paint or written instructions. Another point to be settled is the readiest way in which the cores can be put in the mould. In some cases it is almost impossible to fulfil the foregoing conditions, and to get the cores in the mould in such a manner that the moulder can make provision for getting the air or gases out of the cores.

Patterns should in all cases where possible be parted and dowelled together on the joint line of the mould, as in the case of a cylinder through the centre line of the circle, so that when the top part of the moulding box is lifted off, the portion of the pattern covered by it is taken with it. Then the moulder can loosen each part separately and see what he is doing in drawing the pattern from the mould. It is advisable to lift the pattern from the mould rather than the mould from the pattern. If the moulding box has to be lifted off, leaving the pattern behind, it often results in some portion of the mould breaking down, which sometimes costs a large amount of time to repair. Then it is not true to pattern and very often gives a badly shaped casting due to the patching up of the mould.

Loose pieces, such as bosses and facings, although objectionable, cannot in all cases be avoided. On permanent patterns these should be fixed on by a dovetail. On temporary patterns a screw or wire pin will do, providing the position of the piece is well scribed round on the body of the pattern. Where several pieces have to be loose near each other it is as well to leave one large piece of the pattern loose containing them all, providing there is sufficient room in the mould to allow this being drawn in. Another method of getting over the difficulty of several loose pieces is to put them all together in a core. The objection to this is that in dry sand work it often leaves a mark on the casting if the core cannot be put in green and dried with the mould.

In constructing large patterns wide pieces of timber should be avoided because of the shrinkage and expansion. Frames made of narrow pieces and half lapped together at the corners can often be used with advantage. These are stronger and retain their shape better than large flat pieces. There is also a considerable saving of timber by this method.

Patterns made of dry timber will expand when left in the mould for any length of time and contract when stored away. In boarding up large surfaces, open joints say $\frac{1}{8}$ of an inch between each joint should be left. All screwholes should be bored larger than the diameter of the screw to allow free movement when the boards expand or contract. Where possible the grain of the wood should run in the direction that the pattern is going to be drawn from the mould. As little end grain as possible should be left exposed to the sand. If it cannot be avoided it should be placed so that it is the first portion of the pattern which leaves the mould when it is drawn out. If it is in the bottom of the mould the other way of the grain will shrink and leave the end grain projecting, which will pull a part of the mould up when the pattern is drawn out. This is often the cause of the moulder having to do a considerable amount of sleeking to the mould.

In large patterns, such as bedplates, etc., good provision should be made for rapping and lifting, as it adds considerably to the life of the pattern. In the joint or side of the pattern from which it is going to be lifted from the mould, stout timbers should be put in to receive rapping plates, connected to the bottom of the pattern by struts or stays. Lifting bolts or straps should go through the body of the pattern. In cases where bolts are used there should be a plate let in level with the bottom of the pattern and screwed to receive the bolt. Where this system is practised it is usual to have all lifting plates screwed one size, then one bolt will do service for several patterns. The screwed ends of the bolt should be well tapered off to give it a lead into the bottom plate. The top end should have an eye at least 2 inches in diameter, so that it will receive the hooks which are in general use around this class of work in the foundry.

There is a certain amount of suction in lifting a pattern from the mould in addition to the weight of the pattern itself. Then there is the question of taking the pattern backwards and forwards to the pattern stores. If lifting irons can be relied upon, it is better to lift by them than by rope or chain slings, for these generally leave their mark on the pattern. In fact, heavy standard patterns are often more damaged in lifting about than in actual use in the foundry.

The question of taper is often a very debatable subject between the pattern-maker and moulder. It is seldom the moulder complains of there being too much, but excess of taper often means more machining than is necessary. There is no standard rule; each piece of work requires separate consideration. In most cases ⅛ of an inch to the foot is found to be sufficient. On castings that have not to be machined it is customary to make the given dimensions half-way down the pattern, so that the pattern at the top of the mould is over the size, and at the bottom under the size. If taper were shown on the drawings, on deep surfaces that have to lift vertically from the mould, it would save an amount of time in fitting brackets, etc., on what are supposed to be vertical faces. The brackets would then be designed to suit the taper. On the inside of ribs and brackets where size is of little consequence, more than ⅛ in. to the foot may be given, providing it does not look unsightly or add much to the weight.

In complicated patterns sometimes pieces are left so that the moulder has to lift a part of the mould away before he can draw the pattern out, or, in other words, make a "drawback." This is an expensive method to the foundry. It can often be overcome by a core print being put on the pattern and a box made to suit. It incurs extra cost in making the pattern; still this fact should not be lost sight of, that it only has to be done once in the pattern-shop, but every time a casting is made off the pattern in the foundry. If this extra cost is divided by the number of castings required, it will be readily seen that the "print and core-box" is often the cheaper method to produce the casting; for this should be the aim of the combined efforts of both pattern-maker and moulder. Where the core method is used, great care must be taken that the piece which forms the part of the core matches the mould; if it is possible this piece should be worked on the pattern in its place, then taken off and put into the core-box. This will ensure getting a good joint and only a very slight mark on the casting.

Prints that lift vertically should have more taper than other parts of the pattern. In no case should the taper be less than ⅛ in. to the inch. The size of the core is the size of the print near the pattern. In prints where the core comes through the top moulding box for convenience of centering or releasing the core, etc., the size of the print is still kept the right size near the pattern, but tapered larger to give clearance for passing the core down as shown in Fig. 1.

No two prints on a pattern should be the same size, or nearly the same size, or probably the mould will be cored up wrong. In prints that mould horizontally the root should have a slight champher on it as shown in Fig. 2, as this prevents the edge of the mould breaking down when the core is put in. If this is not done the

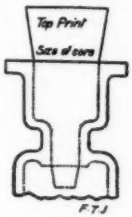

FIG. 1.

moulder generally takes it off with his trowel each time he makes a mould.

Cores are often more difficult than the outside of the pattern; it often takes considerable time to arrange them so that they may be put in the mould in the readiest possible way. Circular core-boxes are generally dowelled together on the centre line for convenience of ramming up and getting the core out of the box. Intricate boxes often have to be made in several parts; where any doubt exists as to the best way of making it, the core-maker should be consulted as to the handiest way for him to arrange for his core-irons and vent passages. Large sized boxes should be made so that they

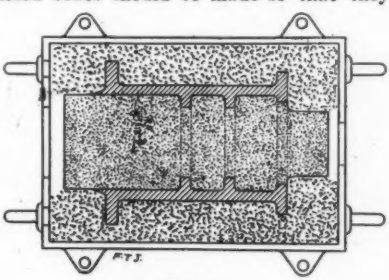

FIG. 2.

can be taken to pieces, and the corners rabbeted together so as to ensure them being put together in the same place, and not trusting entirely to the screws going in the same holes. In boxes for standard work wood screws should not be used, as the constant taking them in and out wears the holes, and the core is made larger than required. Bolts should be used for screwing the boxes together with suitable

shaped handles or wing nuts. These are more quickly released than wood screws, and soon save the extra cost. In no case should the ordinary hexagon nut be used, as the time that should be saved is lost in hunting for a spanner of the right size.

In large cores allowance has to be made for the expansion of them in drying; $\frac{1}{16}$ of an inch to the foot is found sufficient if the cores are dried at the usual rate. This point (which is not recognised by some pattern-makers and moulders) is often the cause of considerable delay due to the time taken in rubbing the cores down to give the required thickness of metal. After the core has been dried, the best test is to try and place it in the box in which it has been made. It is accounted for by the core-iron expanding while the core is being dried and pushing the sand out with it. The core-iron contracts in cooling, but the sand on the outside of the iron is baked hard and does not move back with it.

Large cores should, where possible, be made the same way up as they are to be put into the mould, for convenience of getting at the iron to lift them by when fixing.

Where cores have to bore out to exact centres in relation to each other, as in the case of motor cylinders, where two or three cores are in the same casting, these should be made in one core box tied together by continuous prints at both ends, as shown in Fig. 3. This admits of a good stiff core-iron which can readily be broken without any risk of breaking the casting. It is a quick method of coring up, as all the bore cores are put in at one operation, as well as keeping their centres exact, at the same time simplifying the moulding of the pattern.

Where diaphragms, valve facings, etc., on the inside of the casting, have to be put in a particular position in relation to the outside of the casting, a key must be put on the core and its print. This should be put on the joint of the mould where it can be seen when coring up. It is often found useful to make the print on the pattern smaller than the required size of the core, so as to form a shoulder on the core, as shown in Fig. 2. The core can then be put up to the end of the mould; this will give it a definite position lengthways independent of the ends of the print, from which the moulder often finds it convenient to cut the sand away. This shoulder should be made in proportion to the size of the core; it must not be less than $\frac{3}{8}$ of an inch increasing up to $1\frac{1}{2}$ in. in large cores. If it is made too small it will get a thick coat of blacking and do more harm than good.

In small cores where great accuracy is required and where the metal is very thin the core should be made about $\frac{1}{32}$ of an inch smaller in size than is required, to allow for blacking, and care must be taken that the cores fit their prints, for when once rubbing is commenced on the core no two castings will be identical. In this class of work the first casting that is made off a pattern should be cut up to see that all parts are of the required thickness.

Core boxes that are made to suit taper prints should be the exact size at the point where the casting commences, but should be slightly less than the top of the print; this will ensure them going in easily and tightening themselves when they are down in their right position. Core-boards that are to be used for cores of which large

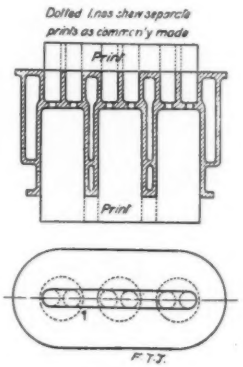

FIG. 3.

quantities are likely to be required, should have a thin sheet of iron on the striking edge, filed to the exact shape of the board; on the top side two strips of iron should be screwed on, giving the exact size of the prints into which the core is to fit, otherwise after a few cores have been made the board gets worn and often gives considerable trouble both to the moulder and machinist.

Large work, such as condensers, flywheels, pipes, etc., are usually swept up in loam, very little pattern-making being required, as loam-boards are used to make both the inside and outside, all projections having to be built in the mould. Work of this type is usually cast upon end. These do not contract the ordinary amount $\frac{1}{20}$ is sufficient to allow in this class of work. Loam work, as a rule, takes more time in the foundry than when a patten is used. No doubt it is the correct method

to follow when two or three castings only are required, but when this amount is exceeded the cost of a light skeleton pattern, against the extra time each casting will take to make should be considered. A case of this kind was given in the "American Foundry Journal" some time ago, where an American company had six sets of large engine casting to make; the first one or two of each of the larger pieces were struck up. Afterwards it was decided to make patterns and moulding boxes to suit. In finishing the remainder it was found to be both cheaper and quicker and the castings better to shape. This question is often settled by the tackle that exists in the foundry, for plates, binders, etc., required for loam-work, are expensive items. Another way of handling work of which only one or two castings are required is to make the outside in cores. This can often be done very economically, for one or two core-box shells with different internal fittings may be made to do duty for all the cores required. This method cuts the pattern-making down to a minimum. In large

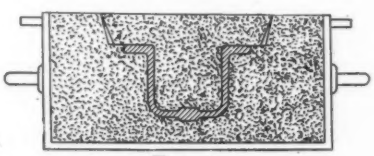

FIG. 4.

work of this class especially, the pattern-maker and moulder should try to avoid getting into set grooves of working, for the method has yet to be found that is economical and suitable for all work.

Light castings, such as covers, cap, cone-pulleys, etc., may be made so that the core takes the place of the top moulding-box and is self-centering, as shown in Fig. 4. This core must be at least 1½ in. thick and 1 in. larger all round than the casting, so that it will bear sufficient weight being placed on it to withstand the lift while the mould is being poured. The print should have a large taper; this makes it simpler both for moulding and coring up. It is important in this method of work that the core fits its print, and that no blacking is put on that portion of the core which goes into the print. Patterns of this description, if they are circular, should be built up in segments, or framed up if square.

All circular work on standard patterns larger than about 10 in. diameter should be built up in segments; it has the advantages of being stronger, does not shrink or expand, and retains its shape better than when cut out of the solid wood. The "trimming machines" now used in most pattern-shops have cheapened this class of work. Built up work often can be made to leave its own core with advantage, and so save the time and material that would otherwise be spent in making a core-box. The writer does not recommend building up flanges, etc., in less than three courses; in fact, two courses are very little better than when cut out of the solid. In pipes, cylinders, etc., "lagging up" is resorted to when the diameter of the work is large, partly to economise material and to secure a form which will be at least affected by the distorting influence of shrinkage and expansion. Lags are usually made from 3 to 5 in. wide, and the number that go to make up a diameter is determined by the size which can be cut most economically out of the width of a plank. In large diameters the rings on which the lags are fixed are built up in segments; this makes a very light but rigid pattern. This method of lagging up is not confined to circular work only, but is used on curves wherever a radial line can be fixed. There is often a difference of opinion as regards the right amount of contraction to allow on special large work, but the writer thinks that most people are fairly well agreed that for general castings 1 in 120 is found to give the most reliable results, and most pattern-maker's rules are now made to this allowance. Steel and malleable iron of different makers often vary much in the contraction. In large size castings in these metals the safest way is to ask the founder what contraction should be allowed; on small work the following table can generally be relied upon:—

General iron	$\frac{1}{120}$
Loam work cast vertically	$\frac{1}{200}$
Brass	$\frac{1}{64}$
Phosphor bronze...	$\frac{1}{100}$
Steel	$\frac{1}{48}$
Aluminium	$\frac{1}{64}$
Malleable iron	$\frac{1}{64}$
Lead	$\frac{1}{48}$

Painting and Varnishing of Patterns.

Various opinions are held by pattern-makers on this subject, but all agree that patterns, except those of the most temporary kind, should be painted or varnished, as it preserves the pattern and fills up the grain of the wood, so that the sand does not cling to it when the pattern is being withdrawn from the mould. One good method that is practised by some of the larger firms is to paint "black" parts

that are not to be machined, "yellow" parts that are machined, and "red" for prints and parts where the core cuts through the metal. In parted patterns the section is painted in the joint. This method enables the moulder to see at once what parts are going to be machined. It also shows him the arrangement of the cores and the thickness of metal, so that he can see where to cut the runner-gates to the best advantage, without having to correspond the core-boxes with the pattern, thus saving the time which would be taken in doing so. It also assists the pattern store-keeper in getting out the different core-boxes belonging to a pattern without having to refer to his book or getting the tracing to see how many core-boxes are required.

Upon finishing a pattern all centre lines should be cut in deeply with a scriber; this makes it much quicker to check the pattern, and also to make any alterations to it, as most of the principal dimensions are given from the centre lines.

Makers of different kinds of machinery have a system of marking their patterns best suited to their own class of work. Standard patterns generally have the marks cast on in raised letters or figures; this mark should also be stamped plainly on the pattern, core-boxes, and all loose pieces that are used with it. A method that is now being employed for small patterns is to have the "pattern-mark" stamped on a strip of aluminium by an automatic machine; this gives a fairly good mark on the casting if a little extra care is taken by the moulder.

In conclusion it may be well to add that in making patterns they must not be considered as finished articles, but as means which are employed to produce castings. With this aim in view the work should be so distributed between the pattern-shop and foundry that upon receipt of an order for castings it will result in their delivery with economical despatch.

The author wishes to thank Mr. C. Morehead for valuable help given in the preparation of this paper.

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Messrs. M'Kie & Baxter, engineers and shipbuilders, Copland Works, Govan, Scotland, have placed with Sir William Arrol & Company, Limited, an order for an extension which involves the doubling of the erecting and machine shops, the building of a new smithy, new pattern shop, store and finishing shop, and entirely new commercial and drawing offices at Messrs. M'Kie & Baxter's Works.

THE MOULDING OF A BRANCH PIPE.

The branch pipe required to be cast is shown in Fig. 1. A commencement is made by preparing the core. This is done in halves. A thin layer of loam is spread over an iron plate (see Fig. 2), and after it is dried the outlines of the two halves of

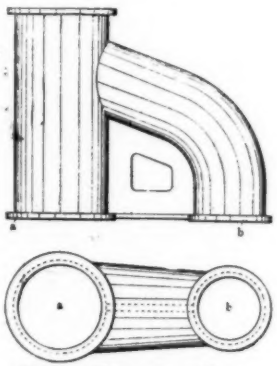

Fig. 1.—Pipe to be Cast.

the core are drawn upon it with chalk. The boards which serve as guides to the templets are then placed in position and weighted. In order that the respective halves may not be too heavy, each is built up of bricks and sand upon the cast-iron plate to the requisite height,

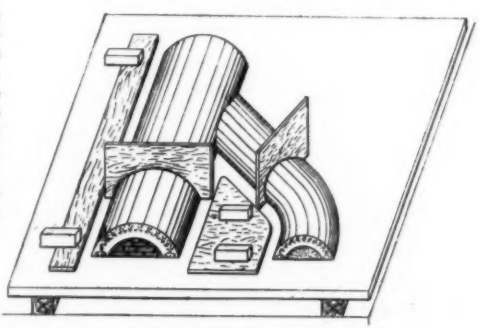

Fig. 2.—Preparing the Core.

and then covered with a thin layer of loam, into which the core iron frame is pressed. The method of making the latter is shown in Fig. 3. Pieces of flat iron are bent into semi-circles, and the various half hoops thus formed are bound together by means

of longitudinal strips, attached by means of wire. In Fig. 3 is likewise shown the core frame in section, and in this cut the longitudinal strips are visible. On the core iron frame thus pressed in the loam a coat of the latter is spread, and shaped by means of the templet (see Fig. 2), and the joint is fashioned by hand. The two

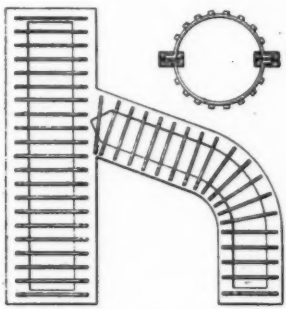

FIG. 3.—CORE FRAME WITH WROUGHT IRON RINGS.

halves of the core thus prepared are dried, and then provided with an isolating layer consisting of sifted ashes to keep separate the temporary external coat to be shortly applied, and to prevent its becoming solid with the core. This coat, which is the

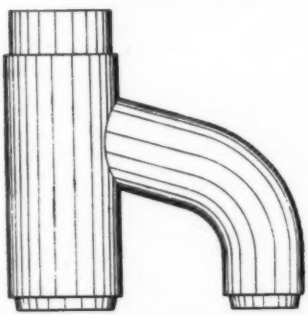

FIG. 4.—LOAM PATTERN, MADE BY COVERING THE CORE WITH A TEMPORARY COAT OF LOAM EQUAL TO THE THICKNESS OF THE CASTING.

same thickness as the casting to be made, is laid on in loam on the halves, when they are dried are bound together with wire, and thus is obtained a pattern in loam for making the casting which is shown in Fig. 4. On the foundation plate (*c*) represented in Fig. 5, the flanges and the core-prints (*a*) and (*b*) for the branch are fashioned (see Fig. 4). The whole is then dried, and the position of the connecting rib is then marked. In the core prints (*a*) and (*b*) is placed the loam pattern, and the space at the flanges is filled with sand. A thin layer of loam is then put on, after

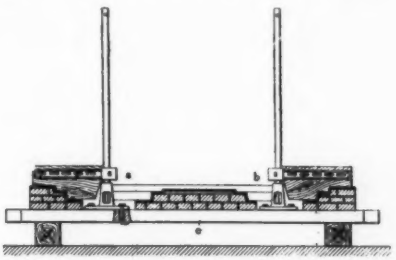

FIG. 5.—MAKING THE FLANGES *a* AND *b* (SEE FIG. 1) TOGETHER WITH THE CORE-PRINTS.

which the two plates (*e*) (see Fig. 6) are laid on. The latter are provided with two lugs (*g*) cast on them. These are introduced for the purpose of fastening the

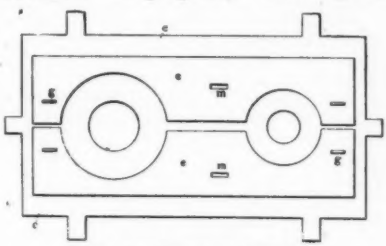

FIG. 6.—FOUNDATION PLATE.

mould together. In addition to these, on each plate there is an aperture to admit the runner. Before, however, putting the two plates (*e*) in position a thin sheet, cut

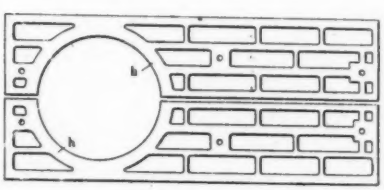

FIG. 7.—PLATES FOR HOLDING MOULD TOGETHER.

out to correspond, is placed vertically, which divides the middle mould into two separate halves, which can be lifted away from the loam model. The former are now built up in brick upon the plate (*e*),

in which operation the four tie-rods (see Fig. 8) which engage in the lugs upon the plate (*e*) are embedded in the masonry, and provision is made for the two runners. When the brickwork is run up as high as

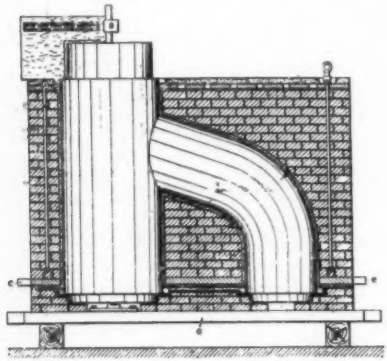

FIG. 8.—MAKING THE MOULD FOR THE CASTING.

the loam model the two plates (*h*) (see Fig. 7) are laid on, and by means of the embedded rods firmly connected with the plates (*e*). The upper flange is next made by means of a striking board, as shown in Fig. 8, and the entire mould is then dried. After this is done, the two halves are lifted

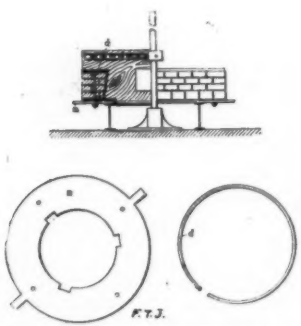

Plate for the head. Ring for the head.

FIG. 9.—MAKING THE HEAD.

off, and in one of them the core which is to make the opening in the rib is fixed, and they are then blackened and made ready for use. The temporary external coat of loam on the core is now removed, and the two halves of the mould are then put in position. In Fig. 9 the method of making the head is shown. Upon a cast-iron plate (*n*) brickwork is laid, and the head is then fashioned in a reverse position. Upon the last course of bricks the wrought iron ring (*d*) is laid and firmly connected to the plate (*n*), so that the dried mould of the head can be turned over and placed upon the two halves of the large mould. The opening in the plate

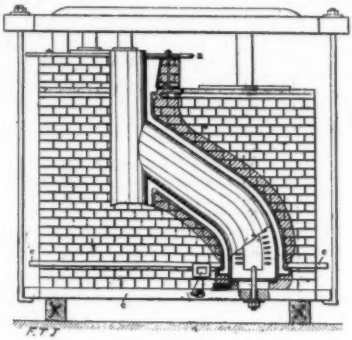

FIG. 10.—METHOD OF FASTENING COMPLETED MOULD TOGETHER.

serves as a guide to the core. In Fig. 10 is shown the mode of fastening the entire mould together.

THE "M. R. V." PORTABLE MELTING FURNACE.

THE latest crucible furnace, called the "M. R. V." portable and tilting crucible furnace, differs in many respects from any other. This has been patented by Mr. Matthew Harvey, of Messrs. M. Harvey & Company, Limited, brass- and iron-founders, Walsall, who have had it in use themselves for some time melting brass, nickel, and German silver, alternately.

The furnace is now being placed on the market, and is in the hands of Messrs. Shaw, Cooper & Company, Imperial Buildings, Dale End, Birmingham, and James Evans & Company, Britannia Works, Manchester. The furnace, as will be seen from the accompanying photos, requires no special plant. It consists of a steel cylindrical shell, lined with fire brick, which also carries a circular tuyere plate, which is specially constructed so that the blast cannot come directly on to the crucible. This plate has an ingeniously designed bottom to facilitate the cleaning and patching of the lining without removing the crucible. The whole is encased in an outer shell of steel, leaving a space between, in which the blast entering the top of the shell circulates

round the furnace, and so gets hot before entering the tuyeres, also keeping the outer shell cool, which is a great advantage to the operator. The bottom of the shell is faced so as to make an air-tight joint with the bottom of the furnace.

This is made concave for the purpose of catching the metal should the crucible prove faulty or break, and is raised or lowered by the lever at the side.

The top of the furnace has many new features. The spout is screwed directly over the crucible, making it secure so that there is no possibility of the metal running through.

The pot comes level with the top plate, and fits against a special fire brick at the front, and by a small key brick at the back.

The coke space between the crucible and the brick lining is covered with a circle of fire brick, which is constructed as to act as tuyeres for the escaping gas, throwing them directly over the crucible into the funnel shaped pre-heater, which latter fits directly over the crucible, thus

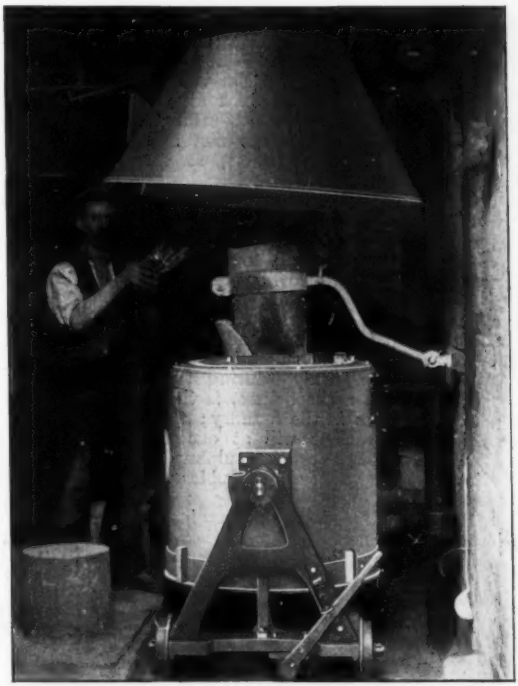

FIG. 1.—THE "M. R. V." FURNACE, BUILT BY JAMES EVANS & CO., MANCHESTER.

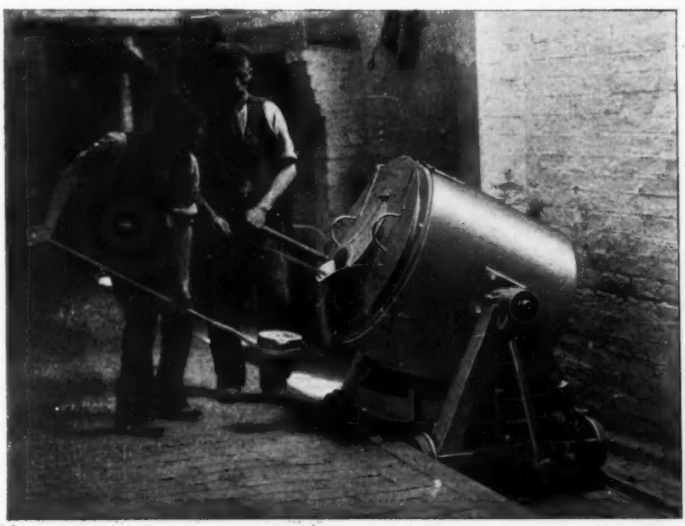

FIG. 2.—THE "M. R. V." FURNACE, BUILT BY JAMES EVANS & CO., MANCHESTER.

softening a large quantity of scrap or other metal before entering the crucible.

The pre-heater, or feed-heater, as shown in Fig. 1, is of special value. The heat in most furnaces which arises from top of the crucible is not utilised, but here is forced through the metal in the feed-heater which softens it, so that it drops down into the molten metal in crucible, and is melted very rapidly.

Fig. 2 shows "pouring," and a special feature here is that of the portability of the furnace, owing to the extreme ease of running the furnace on tram lines to the moulds. All the work of milling, skimming, and speltering can be done in a small adjoining shop, and thus reduce to a minimum and sulphurous fumes in the workshop. Only during pouring, which occupies a short time, is there any poisonous fumes in the foundry; this particular improvement will at once appeal to all brassfounders, the sulphur fumes being one of the great troubles of the trade.

The furnace being self-contained, the last heat of metal is just as hot as the first. The working of the furnace is simplicity itself. Coke consumption varies according to metal melted in brass scrap—60 lbs. of coke will melt 4 cwt. of metal in from 45 to 55 minutes.

The life of the plumbago crucible is considerably lengthened by not being taken out of the furnace until finished with, and will last 5 or 6 days' work with 6 or 7 heats per day, thus bringing the cost per ton for crucibles to a lower point than has been previously done.

The lining lasts about 12 months, only requiring to be "'ganistered" twice per week, where heat has caught same, and when the cost of this is put against that of keeping 7 or 8 pit furnaces in repair the economy effected is obvious.

Messrs. Shaw, Cooper & Company, 36, Imperial Buildings, Dale End, Birmingham, and Messrs. Jas. Evans & Company, Cross Street, Blackfriars, Manchester, will be pleased to answer any enquiries and make arrangements for the furnace to be seen in operation.

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Mr. E. Nettlefolds, of Guest, Keen & Nettlefolds, has been elected to a seat on the board of Lloyds Bank.

Mr. George Ainsworth, general works' manager of the Consett Iron Company, Limited, has been appointed general manager of the company, and Mr. E. J. George, from the Wigan Coal & Iron Company, has been appointed secretary in place of Mr. H. Holliday, resigned.

THE SURFACE HARDENING OF STEEL.

The process of cementation is one of the oldest in the metallurgy of iron. The ordinary operation of case-hardening is also a cementation process, and this, in various modified forms, is still most important, being employed alike for the improvement of the small parts of modern automobiles, and equally for the perfecting of the massive pieces of armour plate of the latest types.

In a paper recently communicated to the Société des Ingénieurs Civils de France, by Mons. Léon Guillet, the manner in which the operation of cementation, or surface carbonising, is effected is discussed at length, use being made of the microscopic study of the structure of the metal under various conditions.

Until recently the operation of cementation was one concerning which but little was known from a scientific point of view, nearly all the practical work being performed according to empirical methods, acquired by experience, and often jealously guarded as valuable trade secrets. Mons. Guillet has shown that the process is one entirely capable of reduction to a scientific and rational system, and he examines its details in a most interesting and valuable manner.

The object of cementation is the production of a piece which shall be tough and resistent in the interior, while the exterior surface is given a certain degree of hardness suitable to stand wear or abrasion and capable of receiving a finish possessing a low co-efficient of friction. In order to produce this result the article is made of mild steel and then surrounded with carbon and subjected to a temperature sufficiently high to cause the carbon to dissolve in the iron. This gives a surface rich in carbon, while the interior remains unchanged, and a subsequent tempering permits the production of a surface of any degree of hardness desired.

By a series of experiments the author obtained the following information as to the course of the cementation process.

In the first place, the rate at which the cement carbon penetrates the metal is the same for all percentages up to 0.51 per cent. of carbon in the original steel. Secondly, the velocity of penetration must be determined for each cementing material employed. With nearly all the cementing agents examined, the final degree of penetration at the end of eight hours was found to be the same, but wood charcoal gave considerably lower results (2.5 millimetres as compared with

3 to 3.25 mm.), though behaving normally at the outset. To determine whether this decline is due to the presence of potassium carbonate and its conversion into the corresponding cyanide, experiments were made, and the results seemed to warrant the assumption that the diminished activity of the charcoal is due to the volatilisation of the alkali cyanide.

Turning to the influence of prolonged heating on the strength of the cemented bar, it was found that the resistance of the metal to shock varied inversely with the temperature of cementation. In view of the known fact that the brittleness of steel increases with its carbon content and the time for which it is heated, it would therefore seem desirable to perform the cementation process with steel of low carbon content, in the shortest time and lowest temperature possible. Other considerations, however, make it preferable to work with steel containing 0.1 to 0.15 per cent. of carbon, the maximum not to exceed 0.2 per cent., though this percentage is considered the best by some. The proportion of manganese should not rise above 0.35 per cent. The temperature of cementation should be such that the desired penetration ($\frac{1}{50}$ to $\frac{1}{20}$th inch) is obtained in about eight hours, and the working limit may be fixed at 850 degrees C., provided this be maintained at a constant level. The usual practice of tempering the steel directly it comes from the pots, without knowing its exact temperature, should be abandoned, the metal being placed in an annealing furnace until it has cooled down to 800 degrees C., and then tempered.

With regard to the class of furnace for cementation, those heated by gas are preferred as more easily regulated than coal furnaces. The set of furnaces illustrated in Figs. 1 and 2 has been erected recently at the Dion-Bouton Works, as a battery of six furnaces for working at temperatures up to 1,200 degrees C., the temperature being adjustable to any desired degree, and the internal atmosphere of an oxidising or reducing character according to requirements. The furnaces are fitted with regenerators for heating the air. The flame rises through a flue at the rear of the bridge and spreads over the arch of the furnace, the sole being heated by radiation. The products of combustion are drawn off through corner orifices at the level of the sole, and are conducted through flues into the air regenerator.

FIG. 1.—BATTERY OF SIX CEMENTING FURNACES, SHOWING THE FURNACE BOTTOM TRUCK.

The furnaces are closed by counterpoised sliding doors, formed by hollow refractory plates set in a metal frame, and provided with peep-holes for watching the interior and measuring the temperature. The sole plates are constructed of metal frames covered with a thick layer of refractory material, and rest on shoulders in the side walls of the furnace. The soles are introduced and withdrawn by means of a truck (Fig. 2), which is run into the bottom of the furnace. The top frame of the truck

can be raised by means of a worm gear actuated by a hand wheel, so as to lift the sole from its bedding, and enable it to be drawn out of the furnace for conveyance to the hardening shop, without delay or risk of cooling.

The working temperature (850 degrees C.) is controlled by a Féry radiation-pyrometer, which is of the thermo-electric couple type.

In studying the effect of the presence of small quantities of other metals on the results of cementation, the author has found that the addition of 2 per cent. of nickel to ordinary cementation steel entirely removes the shortness incidental to the latter. It is therefore advisable to employ an addition of 2 per cent. of nickel,

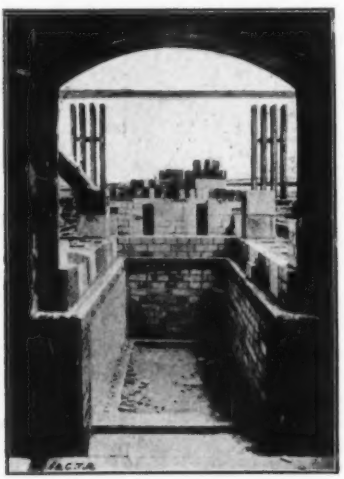

FIG. 2.—INTERIOR OF CEMENTING FURNACE.

where the slight extra cost is of little importance; in fact, the reduction of loss by spoiled pieces will quite make up for the difference in cost.

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IN our December issue we mentioned that Messrs. Gilbert Little & Sons, had founded a new works near Birmingham. In order to remove any misapprehension the New Conveyor Company, Limited, of Smethwick, with whom Messrs. Little were formerly connected, have notified their clients to the effect that they have not parted with any of their patent rights, and that Mr. Gilbert Little and his sons are not now officially connected with the company.

THE BRITISH WESTINGHOUSE STEEL FOUNDRY AT TRAFFORD PARK, MANCHESTER.

IN an issue of April, 1903, brief reference was made to the works of the British Westinghouse Electric Company at Trafford Park. Since then the British Foundrymen's Association have visited the works, as well as large numbers of other engineers, who have been much impressed with the steel foundry, which of its kind is one of the most notable features of the works. It is not our purpose to enter into details concerning the works as a whole, as this has already been done elsewhere. The steel foundry presents many points of interest, which have not as yet been fully dealt with. The steel foundry and forge shop are under one roof, but divided by a brick wall, 12 ft. high, having an opening in the centre 18 ft. wide to allow through railway and crane communication. The main features of the foundry are two 20-ton Wellman patent tilting open-hearth furnaces, operated by five Duff gas-producers. The pig-iron and scrap for these furnaces is hauled by a 50 h.p. electric motor up an incline approach from the outside track to the charging platform, on bogies containing the Wellman charging boxes. These boxes with their contained metal are seized by a Wellman electric charging machine, and run direct into the furnace. The charging machine is of the overhead or crane type. The advantage of this design is, of course, that the floor of the platform is entirely free from rails or other obstruction. The melting plant consists of the two 20-ton Wellman-Seaver rolling furnaces already mentioned. These furnaces are of the most recent design, both being electrically tilted through suitable gearing by 75 h.p. Westinghouse motors. The general method of tilting is by hydraulic power, and, so far as we know, these are the only electrically tilted furnaces yet put in operation.

Each furnace consists of a very strongly framed steel shell or casing of an approximately rectangular section, inside which the lining of silica bricks is built up. On the underside of the structure are fixed two curved rockers which roll on, and are supported by, strong steel standards with horizontal upper surfaces; when tilting to pour off the steel, the furnace rolls forward on these rockers. The rolling movement is accomplished by the electric motor.

The sides of the furnace consist of two plate girders, together with a framework of upright channels, tied together and

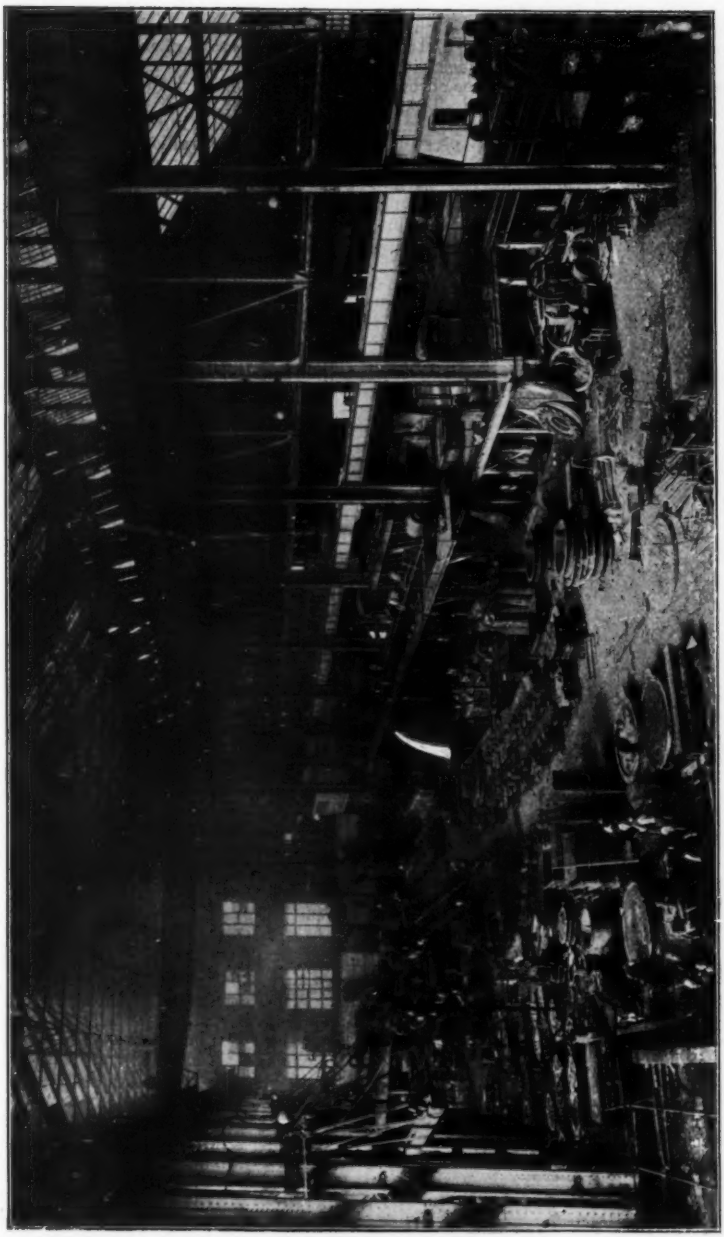


FIG. 1.—STEEL FOUNDRY: BRITISH WESTINGHOUSE COMPANY, TRAFFORD PARK, MANCHESTER.

stiffened by longitudinal tie plates and angles. They are also braced across the top of the furnace by diagonal tie-rods. The two ends are formed of plates, stiffened in the same way as the sides with upright channels, and tied together across the top of the furnace by longitudinal tie-rods. For the passage of the air and gas each end of the furnace is provided with openings round which is fitted a cast-iron water-cooled ring, which registers with a corresponding ring on the port when the furnace is upright. The furnace bottom is framed of heavy steel plates, butt-jointed and well stiffened, with cross channels rivetted together in pairs and

The furnace charging doors are three in number, and are operated by pneumatic cylinders through wire ropes, the leads being arranged in such a way that the doors remain closed when the furnace is tilted. The doors are of ample size to allow the insertion of charging boxes by the Wellman charging machine. They are water-cooled and radiate very little heat, thus allowing the small inspection hole in each door to be used without hardship to the men. There is also a small door provided near each end of the furnace to facilitate repairing the end walls.

The tapping hole is so arranged as to be always above the level of the bath when

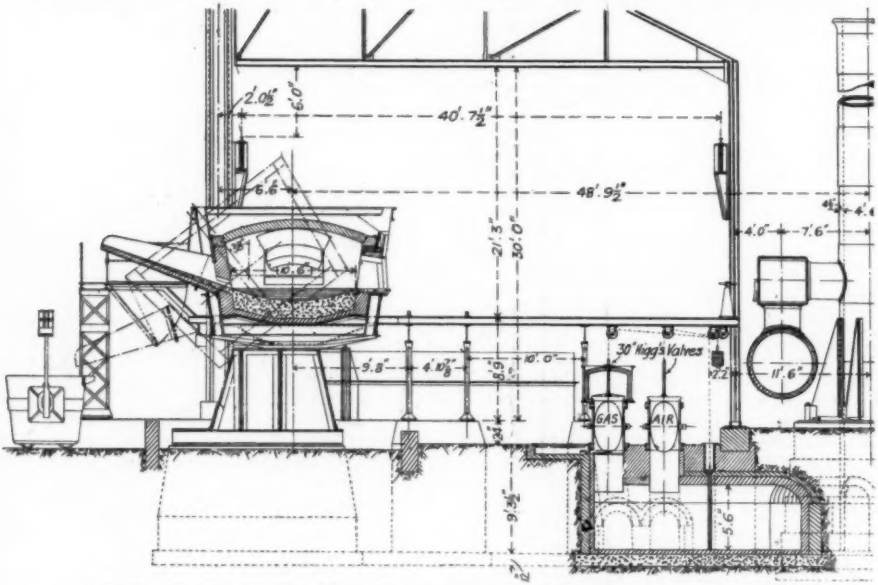


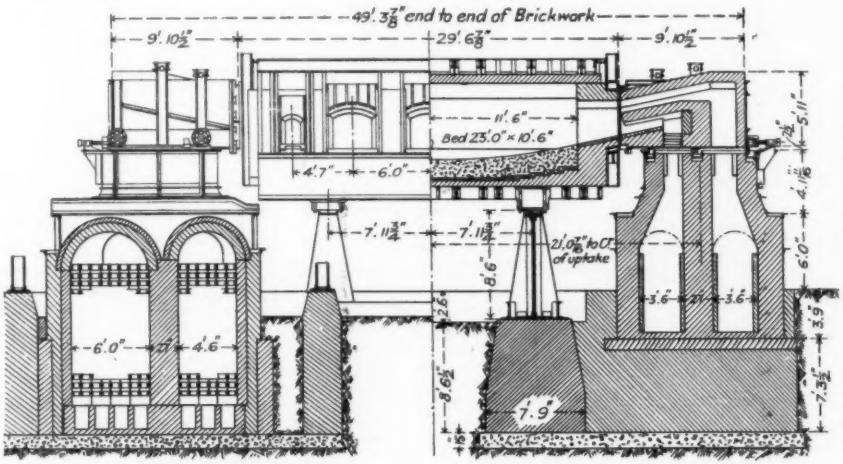
FIG. 2.—SECTION THROUGH OPEN-HEARTH PLANT: BRITISH WESTINGHOUSE COMPANY.

spaced a short distance apart. The rockers consist each of a massive steel casting, bolted to the underside of the furnace body, the rolling surface being curved and provided with rackwork, which keeps the furnace parallel without supporting any of the weight. The pedestals, on which the rockers rest, are built up of steel plates and angles strongly framed together. On the top is fixed a flat steel plate having recesses in which the rackwork of the rocker gears. The pedestals rest on solidly built piers of brickwork, and the base of each has an extension towards the pouring side of the furnace on which are fitted the trunnion bearings for supporting the tilting cylinders.

the furnace is in the melting position. It is fitted with a heavy steel flanged casting, securely bolted to the plates forming the side of the furnace; in the outer flange holes are provided for readily attaching either the fore hearth or the pouring spout, as required by the various operations.

The brickwork forming the ports is built up inside casings of steel plates, strongly bound with angles, each port forming a separate self-contained structure, carried upon four flanged wheels. The uptakes from the regenerators are strongly encased and tied, and are carried up to about the level of the furnace bottom, and across the top of each is laid a

short track on which the wheels of the port rest. Round the upper ends of the two passages leading from the regenerators are two cast-iron water troughs; while round the corresponding openings on the under side of the port are fitted rings which project downwards into the water troughs, thus forming a water-sealed joint between the movable port and the fixed uptake. Sufficient clearance is given to the troughs to allow the port to be moved on its wheels a few inches towards or from the furnace end without breaking the seal. The joint between the ports and furnace body is vertical, and is made by the cast-iron water-cooled rings on the furnace abutting against the corresponding rings on the port. The joint



HALF SECTION THROUGH REGENERATORS.

HALF SECTION THROUGH FURNACE AND SLAG POCKETS.

FIG. 3.—ELEVATION OF WELLMAN ROLLING FURNACE.

is efficient, and the leakage inwards and outwards is negligible. When pouring is about to commence, each port is drawn back a few inches to avoid the friction between these faces, and to allow free motion of the furnace body. The ports can be removed for repairs by an overhead crane, which lifts them from the track and deposits them in a suitable place, a fresh port being substituted. No joints require to be made or broken and the change occupies only half an hour. Two spare ports are kept on the platform for use.

The question most steel foundrymen will ask on visiting the British Westinghouse Company's steel plant is: "What do you gain by having a Wellman rolling furnace?" On this head, we cannot do better than quote Mr. Macmillan, the first superintendent of the Foundry:—

"The hottest part of the heat is received into the bottom of the ladle, consequently there is less loss from sculling. There is never any loss from draining at the tap hole.

"No hot work nor delay on the tap hole.

"Instantaneous tapping.

"The furnace can be charged as soon as it is rolled back in position, thereby making use of practically all of the initial heat.

"If there is a hole in the bottom of the hearth, it can be drained and repaired in a satisfactory manner.

"If a hole occur in the front breast, one can plug the tap hole, roll the furnace and repair.

"The back wall, being built so that the lining extends to the roof, is permanent.

"Having removable port ends, the worn out parts are replaced with a spare set.

"If for any cause, the operator desires to make two tappings from the same heat, he can do so.

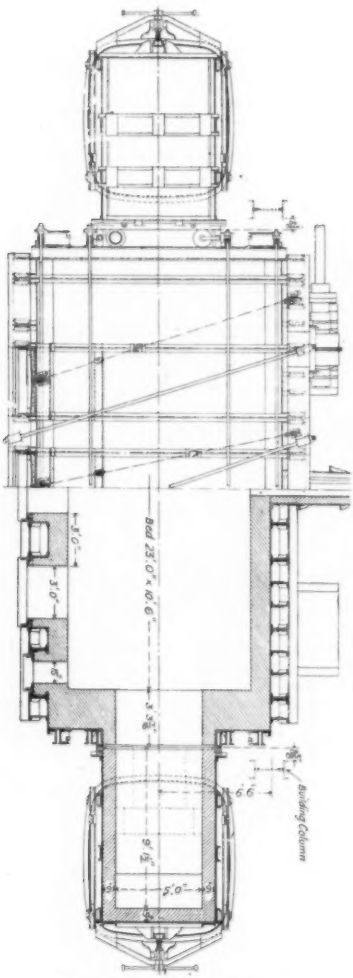
"In a word, it is an open-hearth furnace, machine-like in its operation, and under the absolute control of the operator."

So far as the economy in using the charging machine is concerned, it has been conclusively proved that wages per ton

and the time taken for charging are reduced.

The Westinghouse Foundry is making steel castings, charging one heat per day,

HALF PLAN.



HALF SECTION WITH TOP OF FURNACE REMOVED.

FIG. 4.—PLAN OF WELLMAN ROLLING FURNACE.

consequently the furnace is cold a great part of the time. Against these unfavourable conditions they have charges consisting of 50 per cent. scrap, 10 per cent. cast-iron turnings, and 40 per cent. low phosphorus and low silicon pig. The time of each heat has varied from five hours and twenty-five minutes to six hours and thirty minutes; the average is approximately five hours and fifty minutes. Mr. C. H. MacMillan, the foundry manager, has stated that he tried to obtain pig-iron carrying 1 per cent. phosphorus and 1 per cent. silicon, with not over .05 sulphur, but was unable to get it. Pig-iron was offered having 1½ per cent. silicon and 2½ per cent. phosphorus, or pig carrying 1 per cent. silicon and low phosphorus. Inasmuch as steel castings were to be made with not more than .02 phosphorus and .03 sulphur, and as the works produce many tons of cast-iron turnings, which the steel foundry is called on to use, the low phosphorus and low silicon pig-iron was chosen.

The laboratory attached to the steel foundry is most complete, chemical tests and mechanical tests being carried out in the usual way. There is an Olsen 100,000 lb. testing machine.

In the foundry itself there are two 50-ton and one 10-ton overhead electric travelling cranes, in addition to which there are five air hoists and jib cranes. The cutting-up saws, cold saws, etc., were made by Hetherington & Sons, of Manchester. The foundry has the usual annealing and drying ovens, and there is also a sand-blast apparatus, operated by an electrically-driven air compressor. The pressure of air is 25 lbs., and very fine chill cast-iron dust is used in place of sand, and is found to be very effective. There are also sand mixers and the usual appliances of a foundry of this nature.

It may be added that the iron foundry at these works is also of great interest. This is on the extreme east of the works, and is 600 ft. long and 180 ft. wide. The foundry at present contains two cupolas, one having a capacity of about 18 tons; running along the side is the charging platform, which communicates with a sort of covered platform, railed in, forming a new kind of storage. This store—a unique feature—is built entirely of iron outside the foundry, and has a plate-floor on a level with the charging platform, with railway-truck service below, and a hydraulic lift for raising the metal pigs or scrap direct to the store and charging floor. The wide, centre bay of the foundry is spanned by 50-ton electric travelling cranes. The crab contains two sets of hoisting gear, each driven by its own motor, one for weights up to 50 tons, and the other for light loads of 10 tons and under. The pillars are also to be provided with swinging jib-cranes.

The lighting of the iron foundry is very striking; it is obtained by means of a large number of the new type of arc lamp, known as the "Westinghouse Bremer Light."

A standard gauge railway line enters the iron foundry at each end; the facilities for the transfer and shipment of the large castings turned out are, therefore, of the best, the cranes lifting them and depositing them into the railway cars which carry them into the next shop.

Adjacent to the iron foundry and parallel with it is the brass and malleable iron foundry, a building divided transversely into three distinct parts. At the northern end is the brass foundry, 170 ft. long by 75 ft. wide, and having a large gallery about 25 ft. wide, running completely around it, 30 ft. above the floor. There are at present several furnaces in regular use in this department, the work being the production of smaller details, such as brush-holders, collecting-gear, terminals, etc., for dynamos, parts of arc lamps, instruments, switches; in fact, all the cast brass and copper work.

A brick wall, fitted with automatic fire-doors, separates the brass foundry from the centre portion of the building, which is used as a store for special foundry materials. This part of the building is two stories high, the second being approached by staircases and lifts; the upper floor is divided into small departments, such as chemical and special research laboratories; and a printing department, thoroughly up-to-date, where the innumerable forms, sheets, and publications required by this large establishment are printed; the whole plant is electrically driven. We also print a view of the pattern shop, from which it will be seen that the electric drive is much in evidence.

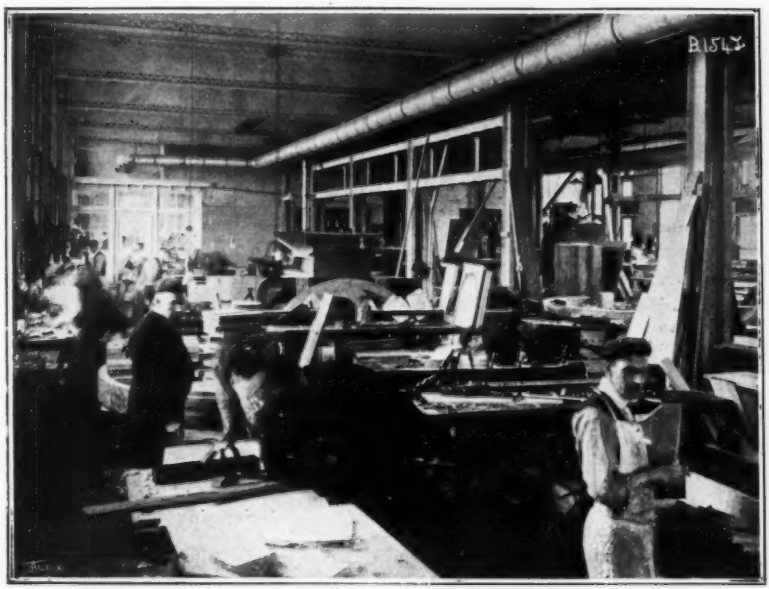


FIG. 5.—PATTERN SHOP AT BRITISH WESTINGHOUSE CO.'S WORKS.

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PRIESTMAN BROTHERS, LIMITED, the well-known engineers, have removed their London offices from 32, Victoria Street, to 3, Laurence Pountney Hill, E.C.

SOME 4,000 tons of Cleveland pig-iron have been shipped this month to Philadelphia at 5s. 6d. per ton freight. We understand that makers' iron has been shipped.

WILLANS & ROBINSON, LIMITED, have been placed upon the list of makers whose steel is approved to be employed in making tubes for Admiralty purposes. The firm recently re-opened their steel works at Queen's Ferry, Flintshire.

CHARACTERISTICS OF CERTAIN BRONZES FOR STEAM USES.*

By Strickland L. Kneass.

The copper-tin alloys in general use vary from 5 to 24 parts by weight of copper to 1 of tin, with a small percentage of either zinc or lead, or both elements. The true binary has a comparatively small part to play in the arts and trades compared with the total amount of bronze in use, because the cost and difficulty of tooling and machining is much greater, and lead, zinc, nickel, phosphorus of aluminium are almost always introduced, producing a beneficial effect upon the physical characteristics. For example, a trace of zinc is used in a 5 to 1 mixture for certain kinds of spindle-bearings or sleeve nuts, producing a metal hard and brittle, having a whitish-grey fracture, machining with a short chip which flies from the tool with great force; care is required to obtain a good smooth surface, but when obtained the bearing wears well under heavy pressures. A ratio of 7 of copper to 1 of tin, and a little more of zinc, makes a good hydraulic bronze, with sufficiently high tensile strength for all ordinary purposes, machining well and running solid in the mould, even with large size sections.

Commencing with pure tin and passing through the various proportions of copper until the latter metal is reached, the appearance of the fracture changes from white, through grey, ash-grey, bluish-red, reddish-yellow to the tile-red of pure copper. The melting point changes at the same time with each increment of copper, until that of the latter metal is reached. According to Mallet, the maximum density of the alloy is somewhat above that of copper, and occurs when the proportions by weight are above 3 of copper to 1 of tin.

The chemical union of copper and tin in more than one or two proportions is disputed by many authorities, although the statement has been made that 1 to 1, 1 to 2, 1 to 3 and 1 to 4 are probably alloys. Be this as it may, in the actual behaviour of the binary alloy in the foundry, owing to imperfect mixing or to other reasons, there is almost always found a certain amount of liquation and a proportion of eutectic alloy which affect the physical characteristics.

This subsidiary alloy is much more in evidence, and its presence and amount of greater importance in the quarternary alloys or mixtures of copper, tin, lead and zinc, with which we have to deal in this discussion. Here there is always liquation, depending upon the form and size of the section and the rapidity of cooling. For this reason, great care is required to obtain a perfectly homogeneous mixture, approaching as nearly as possible a chemical alloy, free from microscopic pin holes due to shrinkage or to occluded gases, and without the harder spots or lumps of eutectic alloy of the constituent metals. This is where the skill and care of the foundryman, designer and moulder, as well as the composition of the metal, play an important part, the rapidity of melting, temperature of pouring, and the condition of the mould itself, all affecting the results.

The essential characteristics of a good steam metal are, homogeneity, solidity, tensile strength, rigidity, facility for machining, fluidity in casting, and non-corrosiveness, all being supplied by the various mixtures of bronze in use in varying degrees of excellence. With reference to the composition, it may be said in general that homogeneity depends upon the causes already cited; tensile strength and rigidity upon the proportion of copper to tin and their preponderance over the lead and zinc, while the form and character of the chip is determined chiefly by the percentage of lead and fluidity by the zinc. The proper mixture for any desired purpose must, therefore, be a compromise, with a fixed tendency toward homogeneity and density, and it is not an easy matter to obtain the desired results in foundry work without careful attention to detail and consistent experiment.

Bronze castings, both finished and unfinished, are subjected in service to two serious deteriorating agencies, namely, the attrition and the solvent action of the contained fluids. These effects are scarcely noticeable on the rough casting, surfaced as received from the mould or after subjection to the sand blast or cleaning bath, but finished surfaces are often seriously affected. The same result that is obtained in the laboratory by etching polished sections occurs in practice on an exposed valve or seat, except that the final result is not so satisfactory; the more soluble metals or alloys are dissolved by the acidulous or alkaline solution, leaving the more resisting and harder eutectic alloy to protrude above the surfaces, preventing continuous contact between the valve faces. Further, the high velocity of the fluid passing through a throttled valve, cuts out the softer parts and a bad leak and defective seat soon result.

* Abstract of paper read before the Franklin Institute.

The porosity of the casting deserves serious consideration, even though the openings be not visible to the naked eye. These defects are seldom observed with a high-power microscope, with the vertical illumination usually employed. The degree of porosity generally depends upon the size of the casting and the part of the section chosen for examination, and is a function of the rapidity with which the molten metal is cooled.

Referring to the effect of attrition in special cases, it may be said that when an injector for feeding boilers is operated at its minimum capacity, the velocity of the jet of water and partly condensed steam may reach 800 feet per second, with a side pressure against the walls of the tube of from 80 to 100 lbs. per square inch. If to the passing fluid be added a percentage of sand or dirt often contained in the water supply, the abrasive effect is rapid. A steam line carrying 200 lbs. pressure gives a maximum velocity of discharge through a throttled valve of 1,400 feet per second. Hydraulic valves made of bronze are frequently subjected to a pressure of 4,000 lbs. per square inch, and the velocity of the water or oil through the constricted orifice between the supply and exhaust may reach 2,400 feet per second during the opening or closing of the valve. The abrasive effect in the cases cited is therefore obvious, and any defect in the surface of the metals exposed to such action is sure to cause rapid deterioration in the operation and efficiency of the device. In injectors made of defective material, the tubes wear out rapidly, not only losing their correct proportions, but, owing to the peculiar action of the jet of steam in apparatus of this kind, grooves and depressions are cut in the inner walls, which cause a ricochetting action from one side of the tube to the other, and which finally prevents the jet from passing into the boiler. The harder protruding spots of the eutectic remain unaffected, while the softer parts directly behind them and exposed to the abrasive action of the fluids, are cut below the normal surface. In the steam-nozzle of an injector, this effect is more marked when a large percentage of water is carried, while dry steam does but little harm to a well-designed nozzle, made of good bronze of even density.

As strength and rigidity are largely questions of the proportions of parts in the design, it is my intention to lay special stress upon homogeneity and density.

Without giving the full details of the investigations, it may be of interest to suggest an outline of the experiments to determine the effect of foundry practice upon the density and homogeneity of certain bronzes. A number of tests were made of various mixtures of copper, tin, lead and zinc having a specific gravity of from 8.5 to 8.9, and an ultimate tensile strength from 25,000 to 30,000 lbs. per square inch. The test pieces were turned to $\frac{5}{8}$ inch diameter and 6 inches long, while the specimens for microscopic examination were flat discs about $\frac{1}{4}$ inch thick and $1\frac{1}{2}$ inch diameter and short cylinders about $\frac{3}{4}$ inch by $\frac{5}{8}$ inch. The test pieces were strained to breakage, and the specimen sections etched and examined microscopically for distribution of liquation, or surfaced for determination of porosity, while the densities of both sets were obtained. It was found that great care was necessary in preparing specimens for examination under the microscope for porosity; a sharp tool and a fine feed must be used to avoid the burnishing effect of a facing tool, as the latter closes up the pores to a great extent; it is also necessary to use a high-cutting speed to prevent the tearing of the metal.

One of the most obvious causes of variation of the quality of steam bronzes is careless mixing of the fluid metal before pouring, yet it is seldom that this is thoroughly done. The great difference in the specific gravities causes the lead to preponderate at the bottom. An extreme case of this kind was proved by specimens, taken from similar castings, poured from the top and bottom of a bail-pot without special stirring; only a trace of lead was found in the first specimen, and the chips curled like steel turnings; the casting from the bottom of the pot contained three times the required amount of lead, was of a dull colour and unfit for use.

A careful determination was afterwards made of results that might be expected under best conditions: four small cylindrical test-pieces of dimensions already given were taken from the first and last mould poured :—

First Mould.	Specific gravity.
Specimen No. 1	8.539
,, ,, 2	8.529
,, ,, 3	8.555
,, ,, 4	8.530
Average	8.553

Last Mould.	Specific gravity.
Specimen No. 1	8.309
,, ,, 2	8.368
,, ,, 3	8.320
,, ,, 4	8.339
Average	8.340

The individual tests are given to show their consistency and the regularity of the

composition of the metal; the difference in specific gravity of the two groups is 2.8 per cent., and the castings made first are slightly denser. Four flat discs from the first mould had an average specific gravity of 8.267 and from the last mould 8.010, a variation of 3 per cent. in the same direction. Two more tests of this kind were made, the differences in the specific gravity of each corresponding closely to the table above, the increase in density in the castings from the first part of the heat being respectively 2.9 and 3.4 per cent. The conclusion to be drawn is that there is no difficulty in obtaining castings of uniform density if the metal is properly mixed. The slight increase in those first poured is probably owing to the lower temperature of pouring, due to exposure during preparation and skimming, and consequent more rapid setting in the mould.

The effect of rapid cooling is well known, and is used successfully with almost every metal or alloy. In the proper production of the steam bronzes it is of great importance and produces a marked effect, increasing the density, reducing the porosity and rendering the etched section much more uniform, causing a great reduction in the amount of liquation and the number of projecting points of the eutectic alloy. Two groups of test pieces were obtained and tested with the following results:—

SHORT CYLINDERS.

	Specific gravity.
Average of specimens poured hot ...	8.661
,, ,, ,, cold ..	8.915

FLAT DISCS.

	Specific gravity
Average specimens poured hot	8.595
,, ,, ,, cold... ...	8.598

Showing a 3 per cent. gain as before for the short cylinders of small diameter, and practically no change for the larger sections. To determine the effect of maximum practical rapidity of cooling, a small casting was made in an iron mould, and compared with sand contact:—

	Specific gravity.
Casting poured in iron mould	9.285
,, ,, sand	8.610

Increase due to rapid cooling, 7.2 per cent.

The appearance of the fracture was different; the grain was closer and the tensile strength was higher. Under the microscope the difference was apparent, there being much less liquation, without visible porosity and with great reduction in the number of projecting points of the eutectic.

Unless excessive internal pressures are used, high ultimate tensile strength is seldom needed, as it is customary to increase the section rather than sacrifice other qualities. When the strength is increased by the addition of aluminium or phosphorus, the expense of remelting the enlarged gates and risers becomes an important item, and there is additional risk of porosity in castings of variable section. Rigidity of form, on the other hand, is of great practical value, so that under strain the castings may not lose their original form of alignment. For all ordinary commercial uses of the steam bronzes, an ultimate tensile strength of from 27,000 to 30,000 lbs. per square inch is sufficient, and to obtain this value as well as both homogeneity and solidity, careful and conscientious treatment in the foundry is required.

As has been shown, the characteristics of any one mixture of metals producing a steam bronze vary with the conditions under which the castings are made. Authorities recognise this fact and give a maximum and minimum value of the specfic gravity, because no absolute value can be taken. The location of the casting in the mould, the size of the section, the contiguity of large and small masses, as well as the conditions already referred to, affect the density and the homogeneity. In my investigations, the specific gravities have been determined by our fellow-member, Prof. A. E. Outerbridge, Jun., a statement of which is a sufficient guarantee of accuracy. Many were repeated several times, and test pieces cut in halves to ascertain if there might be any variation shown by smaller sections. The results may, therefore, be accepted as relatively correct and exact as applied to the specimens submitted. The investigations of these steam bronzes also include the position and location of the pattern in the mould and the methods of gating; where a large and small section are contiguous, it is advantageous to place the heavy part of the pattern, having the larger volume in proportion to surface, in a position where it shall be filled by the first poured and cooler metal; it has been found better in certain cases to place the heavier part above and then gate from the lower end of the smaller section. As the larger part is filled with metal at a lower temperature, it cools in about the same time or slightly in advance of the metal in the smaller section, producing a dense casting, free from shrink holes.

In conclusion, it may be said that in many important lines in which the steam or allied bronzes are in use, there are deteriorating agencies at work, acting both mechanically and chemically upon the ex-

posed and vitally important surfaces, which in time destroy the usefulness of the device; the power of the metal to oppose these forces depends chiefly upon the homogeneity and density, and upon these depends the durability of the apparatus.

Finally, these saving qualities can be obtained only by the use of the microscope and the testing machine and retained by careful attention to every detail in the foundry.

POINTS IN FAVOUR OF CAST IRON.

An enthusiast of cast iron writes as follows:—Amid all the whirling changes of the times, cast iron is still the dominant element in machine construction. This stability and permanence in the midst of the sweeping tide of progress is only a manifestation of the sterling qualities of the material. It is pre-eminently conservative and reliable, and nothing could be more characteristic than its staying quality. What is called treachery and unreliability in cast iron is in fact only its honesty and a proof of its reliability. Its weakness, if we may call it so, is to its credit. It promptly repudiates the task to which it is not adapted, and snaps at once if its load is improperly applied. You may push it and pile your weight upon it, but you may not pull it with impunity. The only danger in the use of cast iron for structural purposes is from imperfect castings, and imperfect castings may be detected by competent inspection and testing. The use of cast iron for flywheels is evidently wrong, especially for high speeds, or for situations where high speeds may be possible at times from the racing of steam engines or similar conditions. The temptation to use cast iron for flywheels is great and likely to continue, although it is diminishing, especially in view of the frequent failures of such wheels. A rim entirely of wire would seem to be the ideal for strength, but it must always be a costly style of construction. The ideal wearing surface is the unwearing surface, and for rubbing or sliding surfaces cast iron is still one of the best materials known, if not the best. Its adaptability for slides and journal bearings is probably largely an expression of its ability to withstand crushing. It is also unique among the metals, in that it works well upon itself. Careful lubrication at the beginning and a little reliable lubrication all the while in connection with cast iron bearings gives wonderful longevity. It is doubtful if the possibilities of cast iron as anti-friction metal are to this day appreciated.

AUTOMATIC CORE OVENS USING OIL AS FUEL.*

By S. E. Barnes.

Gas is the only proper fuel for the core oven, when it can be had. But when gas cannot be had, it becomes necessary to choose between coal, coke, and oil. Of these three articles of fuel, coal is the least desirable for the average core oven, on account of the uncertain quality of fire to be obtained by the draught of a core oven, the time required to get a fire when wanted in a hurry, as is often the case, and the ashes which have to be cleaned out and hauled away each day. The price of coal is fully as high as any other fuel. Coke is somewhat better than coal, as the fire to be obtained from it is sure to be good, when you get it. Coke requires less draught than coal, the result of which is a hotter oven.

But there still remains the want of fire in a hurry many times, when it is not to be had, and the handling of ashes and coke. While these two fuels have served well in the past and will continue to do so in the future, I feel certain that they must give way in time, to some extent to a more modern and convenient fuel.

About three years ago, the management of the shop at which I am employed decided to do something to help the coremakers along, as they were very busy and crowded into small space, as coremakers usually are. The result was the use of oil instead of coke in two large ovens and the purchase of oil-burning torches. At the time that these changes were made, the writer did not consider them of any great importance. But as we became better acquainted with the use of oil, results began to appear in the way of convenience. In many cases where it had previously been necessary to put large cores in the oven the second and third times to dry blackening and joints, the torch does this work in double-quick time, and does it well.

Large patches can be made by the use of the torch, by putting on thin layers at a time and drying each one in turn, which would require much more time and cost by drying in the oven. The torch is also useful to skin dry moulds, thaw the ice and snow from flasks and boards in quick time, and for light and heat in cases of emergency.

At the time we started to use the oil in the ovens the machine shop was very busy, requiring the engine and air com-

* Paper read before the Philadelphia Foundrymen's Association.

pressor to run all day and night, thus furnishing air for the burners at any time except Sunday. When the machine shop became slack, and they ran the engine only in the day time, the small air compressor that was run by steam in the night for the ovens did not furnish enough air; and besides it was always getting out of repair, as well as consuming about as much coal in the night as would be required to run the ovens with coke, not to mention the cost of oil.

It soon dawned upon me that these conditions could not continue long, and being anxious to continue using the oil, I decided to try another way to burn it. Having read of oil being burned to advantage with steam as the blowing force, I tried it in this way. I had often observed the rapidity with which steam is generated by throwing a small amount of water on a piece of hot iron, or into a hot pipe. I acted on this principle and made a cast-iron return pipe, about 3 ft. long, with a $\frac{1}{4}$ in. hole from one end to the other and back, and placed it in the fireplace, leaving the open end flush with the outside wall of the furnace. I then connected the city water to one end of the $\frac{1}{4}$ in. opening and the other end to the air or steam end of the burner, and turned on the air for a few minutes to heat the generator, when the air was turned off again.

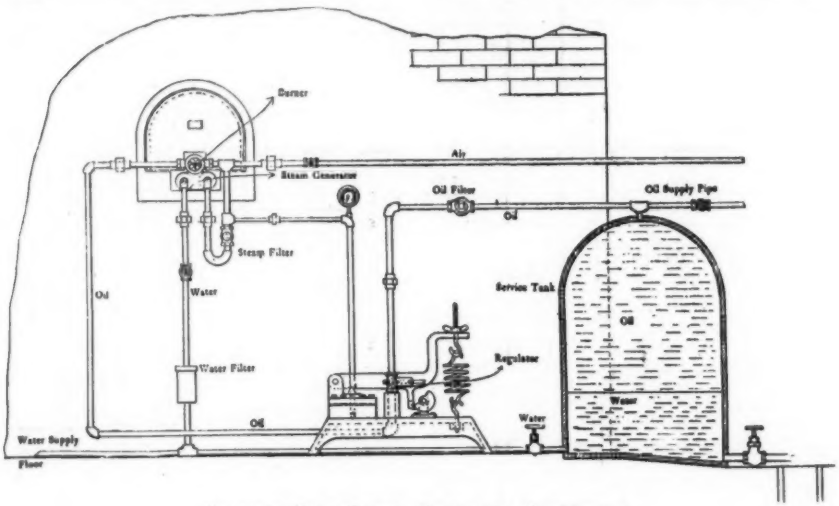
Now to get the steam by the new system, turn on the water by means of a needle point valve, which allows a very small stream of water to enter the generator; thus instantly generating very dry, hot steam at any pressure that may be required by a slight turn of the valve either way.

Thus we have the steam to run the fire continuously; but when there is no air there is nothing to feed the oil to the burner, as the steam is only used to spray the oil into the furnace after both have been brought together by different pressures. The pressure for the oil is obtained by simply connecting the city water to the bottom of the oil tank, thus forcing the oil, which is lighter than water out through the top of the tank to the burner.

This system was used for a time, bringing the cost of fuel down to the actual cost of the oil. But I soon discovered that to complete this system it would be necessary to regulate the oil so that it would flow in proportion to the steam pressure, which may range from 1 lb. to 40 lbs., as needed for the amount of heat required. An old damper regulator was taken from the boiler room and remodelled so that it opened and closed the oil valve automatically with the rise and fall of the steam pressure. This completed the most perfect and economical arrangement for burning fuel oil.

This way of burning oil is the safest, because oil is dangerous only when it is thrown into a hot furnace without sufficient steam or air to spray it properly; then it will instantly explode with some force.

The oil regulating valve prevents the



OIL-FIRED CORE OVENS—PIPING AND CONNECTIONS.

above conditions, because it is impossible to get any oil through the burner until after the steam has been turned on, and then only in exact proportion to the steam pressure. Should the steam pressure by any accident or otherwise cease, the oil valve will be closed at the same time, and locked so that it cannot be opened again should the steam pressure return without the aid of the operator.

This system is the simplest, requiring only one valve to operate, start, raise, or lower it. This is the water valve, by opening which steam is generated instantly, the steam blowing through the burners and the pressure opening the oil valve, all other valves being secondary and precautionary. The system is the cheapest, because it is maintained only by a very small amount of city water or any other water pressure. The whole cost for this oil for core ovens, two torches and large Babbitt's kettle, which is used almost continuously during the day, is just equal to the cost of coke for the core ovens. It is the most convenient system, because a fire can be had at any time, Sunday, Monday, night or day. There is one thing that is not quite as perfect as I think it might be, and that is the generator. It will only last about two months, when it has to be replaced. But the job is small.

I have done it many times with the aid of one helper in half an hour. But I think by the use of different metal, and some protection from the blaze of the fire, the generator can be made to last much longer.

The last thing I have to mention, but not the least, is the filter. The water passes through a fine gravel filter to prevent the rust and dirt of any kind from stopping the flow through the small needle valve. This filter is so connected with valves at top and bottom that the water can be run through it backward, cleaning it out as often as may be required. The oil filter is an ordinary check valve with screw cap, the valve of which is replaced by a perforated plug screwed into the valve seat. This can be cleaned out at any time by removing the cap, about one minute's work. This filter will catch all pipe scales or other dirt that would be large enough to interfere with the oil valve or burner. The air filter is the same as the oil filter, and its purpose is the same.

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MR. W. H. ROBINSON, second engineer to Steel, Peech & Tozer, Limited, Phœnix Steel Works, Rotherham, has been appointed chief engineer of the Frodingham Iron Company, Limited.

TRADE TALK.

THE autumnal meetings of the Iron and Steel Institute will be held in Sheffield on September 25.

MESSRS. C. J. COPELAND & T. R. LITTLE, consulting engineers, etc., of Liverpool, have dissolved partnership.

THE average selling price of pig-iron warrants in West Cumberland for the last quarter of 1904 was 54s. 1d. per ton.

WHYMAN'S FOUNDRY COMPANY, LIMITED, of Warrington, have lately registered a lien for £1,000 5 per cent. debentures.

MESSRS. W. & E. SUMNER, mechanical engineers, of Liverpool, and West Kirby, Cheshire, have been adjudged bankrupt.

THE ERITH IRON WORKS, Kent, of Easton & Company, Limited, in liquidation, are being offered for sale by private treaty.

MR. A. C. MUMFORD, of the Culver Street Engineering Works, Colchester, has registered his firm as a limited liability concern.

A DISSOLUTION of partnership is notified in connection with Messrs. W. Rudge and A. Littley, iron founders, of Ashton, near Birmingham.

THE PHŒNIX DYNAMO MANUFACTURING COMPANY, LIMITED, of Bradford, have opened an office at 17, Victoria Street, London, S.W.

THE WHESSOE FOUNDRY COMPANY, LIMITED, recently booked a very extensive order for gas purifiers for the Edinburgh Gas Corporation.

MESSRS. W. HIRST & J. MITCHELL, trading at Halifax, Yorks., as Hirst & Mitchell, engineers' toolmakers, have dissolved partnership.

REDPATH, BROWN & COMPANY, LIMITED, of Edinburgh, have now completed the erection of their new works at Trafford Park, Manchester.

A. RANSOME & COMPANY, LIMITED, of the Stanley Works, Newark-on-Trent, are opening new London premises at 63, Queen Victoria Street, E.C.

MESSRS. JOHN SPENCER & SONS' Steel Works, at Newburn, were recently the scene of a serious fire. The steel test house was nearly destroyed.

A. B. MACFIE & COMPANY, LIMITED, is the title of a company formed to carry on the business of structural engineers, with a capital of £2,000 in £1 shares.

MR. J. H. EVANS, the London agent for the sale of steel hoops and rods of the Barrow Hematite Steel Company,

Limited, has removed to 39, Lime Street, E.C.

THE ROC STEEL CASTINGS COMPANY LIMITED, has been formed with a capital of £50,000 in £1 shares. The registered office is at Temple Bar House, Fleet Street, E.C.

THE BRANDON BRIDGE-BUILDING COMPANY, LIMITED, recently completed a large quantity of steel-roofing and girder work for the Clyde Valley Electric Power Company.

JAMES CHADWICK (IRONFOUNDERS), LIMITED, is the style of a company formed to acquire the School Hill Iron Works, Bolton, with a capital of £12,000 in £1 shares.

EASTERBROOK, ALLCARD & COMPANY, LIMITED, have established a London branch at 9 and 11, Fenchurch Avenue, E.C., under the management of Mr. H. Allcard.

MESSRS. CUNDALL & SONS having got fairly established in their new works at Shipley, Yorkshire, are now developing their trade in the direction of suction gas engines

NAPIER, SON & COMPANY, LIMITED, has been formed with a capital of £6,000 in preference and ordinary shares equally of £1 each, to carry on the business of iron-founders, etc.

THE NORTHERN ENGINEERING COMPANY, LIMITED, have placed the control of their London and district export and home sales department with Mr. J. E. Lawler, of Lime Street, E.C.

THE members of the Manchester Steam Users' Association will, on February 14, celebrate the fiftieth anniversary of the foundation of the Society by a banquet at the Midland Hotel.

DUNLOP, BELL, & COMPANY, LIMITED, has been registered to acquire the business of Dunlop, Bell & Company, at the Albert Engine Works, Liverpool. The capital is £10,000 in £1 shares.

THE SOUTH DURHAM IRON & STEEL COMPANY are shortly re-starting No. 1 mill at their Moor Works, Stockton, which were laid idle upwards of three years ago through slackness of trade.

BLAIR, CAMPBELL & M'LEAN, LIMITED, has been registered, with a capital of £30,000 in £1 shares, to acquire the business of Blair, Campbell & M'Lean, coppersmiths, brassfounders, Govan.

MESSRS. A. BROWN & COMPANY of 110, Cannon Street, London, E.C., have been appointed the London representatives of Messrs. Penman & Company, of the Caledonian Iron Works, Glasgow.

THE HOLWELL IRON COMPANY, LIMITED, of Asfordby, near Melton Mowbray, have secured the order for the cast-iron pipes required for contract, No. 1 of the Bury and District Joint Water Board.

MR. W. J. DOUGLAS, consulting engineer etc., of 141, Fenchurch Street, London, E.C., has taken Mr. A. Scott Younger into partnership and will in future carry on business as Douglas & Younger.

THE REDBOURNE HILL IRON & COAL COMPANY have completed the sale of their blast furnace plant at Frodingham to Messrs. Monks, Hall & Company, of Warrington, who intend to remodel the entire works.

THE BENRATHER MASCHINENFABRIK A.G., of Benrath, near Düsseldorf, Germany, have established a branch office at 36, Victoria Street, London, S.W., under the style of the Benrath Engineering Company.

THE CARGO FLEET IRON COMPANY, LIMITED, notify that their secretarial department and business office have been removed from the Royal Exchange, Middlesbrough, to the Moor Works, Stockton-on-Tees.

THE shareholders of the Barry Central Marine Engineering Company, Limited, will meet at Cardiff on February 15 to consider the liquidator's report as to how the winding-up of the company has been conducted.

THE partnership hitherto subsisting between Messrs. F. Hirst, W. Mann, and S. Hopkinson, carrying on business as pattern makers and gear cutters, at the Crown Pattern Yorks, Huddersfield, has been dissolved.

WALTER SCOTT, LIMITED, of the Leeds Steel Works, have just completed 2,000 tons of a new section of rolled steel girder, measuring 16 in. deep by 8 in. flange, and weighing 97 lbs. per ft., for the Ottoman Railway Company.

THE business of Mr. J. Shaw at the Central Engineering Works, Mill Lane, Brighouse, has been purchased by a new company, with a capital of £2,000 in £10 shares, who are trading under the style of Beckwith Brothers, Limited.

MESSRS. WILLIAM ARROL & COMPANY are constructing a new 150-ton crane for Messrs. John Brown & Company, at Clyde Bank, similar in many respects to the 150-ton electric crane recently built at Messrs. Beardmore's new Clyde yard.

ROBERT STEPHENSON & COMPANY, LIMITED, have just completed a comprehensive scheme of improvements and additions to their new works at Darlington, which, it is estimated, will greatly increase

the output of locomotives, etc., for the future.

HARRISON & COMPANY, LINCOLN, LIMITED, is the name of a company formed to acquire Harrison's Malleable Iron Works, Lincoln, also the business of Mr. F. H. Harrison, of Hykeham, near Lincoln. The capital of the concern is £50,000 in £10 shares.

THE MANCHESTER AND MILFORD ENGINEERING COMPANY has been formed with a capital of £1,000 in £1 shares, to carry on the business of engineers and iron-founders. The registered office of the concern is at 22, Conduit Place, Spring Street, Paddington, London.

WE learn that the Stirling Boiler Company, Limited, and the Stirling Company of U.S.A., have arrived at an agreement whereby pending litigation has been satisfactorily settled. The former company have acquired all the British and European patents of the American Company.

PHILIP HOWARD LIMITED, has been registered with a capital of £7,000 in £1 shares, to acquire the leasehold interests in the Wauntreoda Works, Llandaff, near Cardiff, and to carry on the business of engineers, iron and brass founders, etc. The registered office is at 10, Commercial Street, Newport, Mon.

THE BRITISH LOCOMOTIVE COMPANY, LIMITED, the Buchholtz Engineering Company, Limited, the Clayton Engineering and Electrical Company, Limited, Harman's Metal Company, Limited, and the Peterson-Stephens' Engineering Company, Limited, have, according to the "London Gazette," been struck off the register, and such companies have been dissolved.

THE GERMAN GENERAL ELECTRIC COMPANY has entered into a working alliance with the Thomson-Houston Company for business in Spain and Portugal. In these countries the allied firms will trade under the style of the Allgemeine Elektrizitäts Gesellschaft Thomson-Houston, or the Thomson-Houston General Electric Company, which has been formed with a capital of 3,000,000 pesetas.

MR. G. P. WILSON, and MR. W. A. WALBER have entered into partnership under the style of Wilson & Walber, to carry on the business of merchants and engineers, at 38, Victoria Street, Westminster, S.W. Mr. Wilson was connected with Cammell, Laird & Company, Limited, for many years, but of late has devoted himself more to metallurgy and mining engineering. Mr. Walber has been long connected with the same company.

NEW INVENTIONS.

List specially compiled for THE FOUNDRY TRADE JOURNAL by MR. GEORGE BARKER, Fellow of the Chartered Institute of Patent Agents, Consulting Engineer and Expert, 77, Colmore Row, BIRMINGHAM.
Telephone No. 1,300. Telegraphic Address—"PATENT, BIRMINGHAM."

1904.

25,612. A. H. WALL. Overhead travelling cranes.

25,892. E. HESKETH. Depriving air of moisture prior to supplying it to cupolas, etc.

25,948. LA SOCIETE ELECTRO - METALLURGIQUE FRANCAISE. Manufacture of steel.*

26,093. R. LINDEMANN. Crucible steel smelting furnaces.

26,297. H. GOLDSCHMIDT and F. LANGE. Joining rails, bars, girders, etc.*

26,299. L. A. GENARD. Manufacture of metallic chains.

26,356. INTERNATIONAL TOOL COMPANY. Pneumatic tools.*

26,441. T. R. HAYS. Smoke from the stacks of factories.

26,442. J. A. HERRICK. Gas producers.

26,716. W. H. BUTLER, and J. BARNSLEY, Adjustable cramp for moulder's casting boxes.

26,845. STEEL, PEECH, & TOZER, LIMITED. Removing the covers of vertical furnaces.

26,849. B. M. BAILEY. Electro-deposition of metals.

1905.

419. COLN MUSENER BERGWERKS ACTIEN VEREIN. Improved method of avoiding or filling up blow holes and like flaws in castings.

775. H. J. B. DELPORTS. Improvements in and relating to the manufacture of steel.

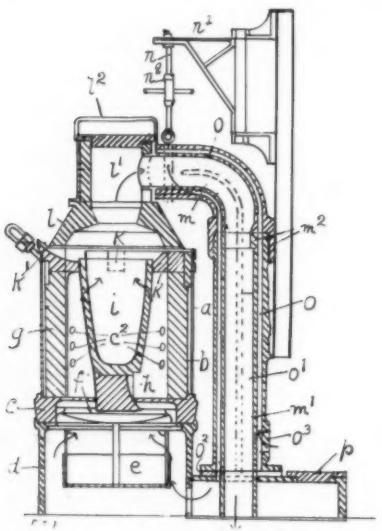
Applications marked * denote complete applications.

9,608. C. W. SPIERS and THE MORGAN CRUCIBLE COMPANY, LIMITED.

This invention relates to crucible furnaces of the kind adapted to be tilted for the purpose of discharging molten metal contents of the crucible without removing the same from the furnace. According to this invention the furnace proper is contained in a metal casing composed of an external shell *a* of polygonal shape and an internal shell *b* of circular shape, so that a series of passages a^1 a^1 is formed between the two sheets. This casing is secured to a base ring C adapted to stand on a closed base plate *d* enclosing an ash pit *e* and carries the

grate *f* and the brick or other refractory lining *g* of the furnace. Within the furnace upon the grate *f* is mounted a stand *h* upon which the crucible *i* is carried. Upon the refractory lining *g* is placed a series of supporting bricks or arms *k k* which engage with the crucible and support it in its proper position, when the furnace is tipped in one of the supports K, in the spout K^1, through which the molten metal is discharged.

The cover (1) which is provided with a refractory lining has in it a chamber l^1 open at its bottom immediately above the crucible and the sand chamber communicating by a pipe *m* with the down pipe m^1 extending to the chimney. This



chamber l^1 allows of the scrap metal being piled up above the crucible, so that as the metal melts it will descend into the crucible. The pipe *m* is pivoted to the down pipe m^1 to permit of removing the cover from the top of the furnace. The cover is swung laterally away from the furnace top. In order to relieve the joint m^2 of the strain the cover and pipe *m* are suspended by an adjustable link *n* from a derrick n^1, the centre of movement of which is an axial alignment with centre of the joint m^2. The link *n* is formed with a nut n^2 so that by rotating the nut more or less lifting movement of the cover *l* can be effected. To promote combustion in the furnace, the passing of the air over the pipe m^1 so that it shall be heated is provided for by the pipes *m* and m^1 being provided with double walls which form an annular passage O. The annular passage is divided by partitions o^1. The lower end communicates with the base *d* at o^2, whilst the other half is provided with an aperture o^3. The air is forced in at o^3 and passes round one half the pipe m^1 and descends around the other into the base *d*, whence it passes in the direction of the arrow into the furnace.

QUERIES.

This department of the JOURNAL *undertakes the answering of queries in foundry practice and pattern making. We trust our readers will afford us assistance in answering these queries so far as possible.*

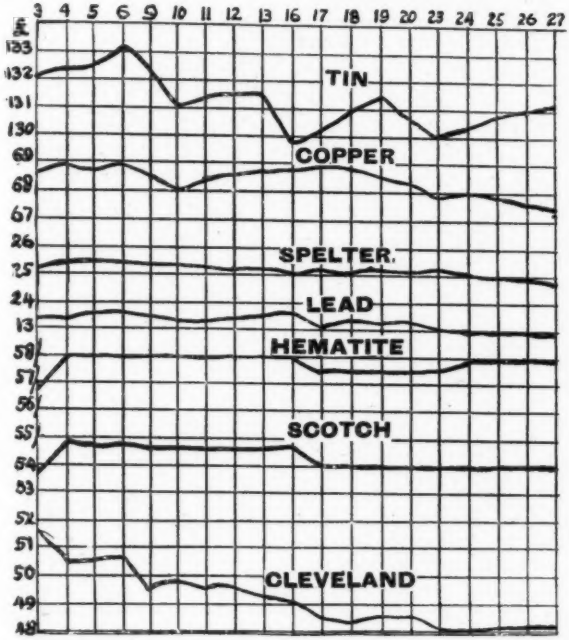
THIN CASTINGS.—"Perplexed" writes:—I should be obliged for some help in the following difficulty in making some light iron castings about 6 in. diameter, $2\frac{1}{2}$ in. deep, and having a bottom, the whole casting being similar to a saucepan minus the handle, the thickness of metal being $\frac{3}{32}$ in. They are invariably very hard, and as a great number of small holes have to be bored in them, this is a serious defect, otherwise they are excellent castings. Can you suggest a soft mixture (Bestwood No. 1 is at present used), or, failing this, a simple method of annealing them, with a rough sketch of suitable oven. A hint as to any literature on annealing would be acceptable.

* * *

TEMPERING STEEL.—"B. F.," London, writes:—Please describe the precautions necessary for drawing temper in large quantities of bits or cutters.

The best way to draw the temper on small articles, as bits and augers, is to immerse them in a fluid of the right temperature and allow them to remain until all have the same heat. A tank of oil regulated by a thermometer is good for any heat less than will blaze oil. Many combinations may be made with vegetable, animal and mineral oils and tallows with beeswax, rosin, salt, soda, etc., to suit any purpose. Even temperature in any fluid must be secured by agitation if not boiling. With skill sand may be used in place of a fluid; skilful handling will let the air to them bring out any colours that are wanted. Bits may be bunched and augers set in frames so that a number of them can be handled as one piece.

CHART SHOWING THE FLUCTUATIONS OF THE METAL MARKET IN JAN., 1905



PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years :—

METALS.	1904-5.	1903-4.
Iron—Scotch pig warrant ... ton	..... 51/0	..... 49/9
—Middlesbro' warrants ... ton	..... 48/2	..... 42/4½
—W.C. M nos Bessemer ... ... ton	..... 58/6	..... 54/0
—Stock, Scotch, Jan. 27. ...tons	 13,403	 9,095
Copper—Chili bars, GMB ... ... ton	£67 12/6–£67 13/9	£56 12 6–£56 13 9
—Stock, Europe & afloat... ... tons	 16,734	 13,851
Tin—English ingots ton	...£131—£131 10	...£128 10—£129
—Straits ... ton	£130 15–£130 17 6	£126 10–£126 12 6
—Stock, Ldn. Hlnd and afft ... tons	 11,284	 10,963
Lead—English pig ton	£12 18/9 –£13 1 3	...£11 17/6—£12
Spelter—Ord. Silesian ... ... ton	... £24 17 6—£25	... £21 10 – £22
Quicksilver-(75lb.) bottle	..... £7 12 6	..... £8 5
Antimony—Regulus ... ... ton	..... £36—£38	..... £26—£27

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings :—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	7 0 0
Pipes, 1½ to 2½ in.	5 0 0	to	5 5 0
,, 3 to 4 in....	4 12 6	to	4 17 6
,, 5 to 8 in.	4 10 0	to	4 12 6
,, 10 to 16 in....	4 10 0	to	4 12 6
,, 18 to 24 in....	4 10 0	to	4 12 6
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 0 0	to	3 2 6

SCRAP.

The quotation for scrap subject to market fluctuations is as follows:—Engineers heavy scrap, 50s. to 52s. 6d.; ditto light scrap, 20s. to 22s. 6d.; clean scrap brass, 37s.; clean scrap copper, 61s.; lead (usual draft), 11s.; tea lead, 10s.; zinc, 18s. 9d.; hollow pewter, 100s.; black pewter, 65s. per cwt.

COMPANY NEWS

TREDEGAR IRON & COAL COMPANY, LIMITED.—Interim dividend of 5 per cent. per annum for the half-year on the A and B shares.

REDPATH, BROWN & COMPANY, LIMITED.—Annual net profit of £12,166 3s. 6d., with £4,551 3s. 11d. brought forward. Preference dividend 5 per cent., ordinary 5 per cent., and share of surplus divisible among preference shareholders, £455 12s. 3d.; ditto, ordinary shareholders, £1.822 9s. 3d. Surplus profits for the preference shares allow extra dividend of ¼ per cent. per annum; ditto, ordinary shares, sufficient to make up dividend to 7½ per cent. for the year (free of tax).

—o—

OBITUARY.

MR. R. C. ELSE, engineer, of Bridgwater.

MR. J. ANDERSON, manager of the pig-iron works of Bolckow, Vaughan & Company.

MR. HERBERT ASHMORE, ironfounder, of Birmingham, and well-known in the stove grate trade. Deceased was in his 61st year.

MR. L. THOMAS, who had been connected with the Rhymney Iron Company, Limited, all his lifetime, latterly as estate agent.

MR. J. J. FROST, of Sheffield, for 30 years the North of England representative of Guest, Keen & Nettlefolds, Limited.

MR. H. WRIGHT, of Small Heath, Birmingham, the first general manager of the Patent Shaft and Axletree Company, of Wednesbury.

MR. E. L. FLETCHER, eldest son of the late Mr. T. Fletcher, of Fletcher, Russell & Company, Limited, Warrington. The deceased was formerly a director of the company.

MR. T. C. DAVIDSON, aged 60 years, partner in the firm of C. E. Muller & Company, of Middlesbrough, and connected with the iron trade of that district for over 40 years.

MR. C. H. REED, of the firm of C. H. Reed & Company, forgemasters, Sunderland. The deceased was in his 73rd year, and in 1855 entered into partnership with Mr. D. Holsgrove, of the Forge, Anchor & Chain Works, Sunderland. The partnership, however, was dissolved seven years later, when Mr. Reed became the sole proprietor.

ELDERS FOUNDRY COKE

As supplied to the British . . Admiralty Dockyards.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blow-holes and other defects, than we formerly did.

From MOUNTFORT PHILLIPS & Co., Llantrissant.

Llantrissant, October 25th, 1904.

In reference to the Foundry Coke you have been supplying us with for the last six months, we have very great pleasure in letting you know that it has given every satisfaction, and that our Works Manager and Workmen give it the highest praise.

Elders Navigation Collieries, LTD. Cardiff.

CORE OVENS

Everything for the Foundry.

JAMES EVANS & Co.,

FOUNDRY ENGINEERS,

BRITANNIA WORKS, MANCHESTER.

EVERY DESCRIPTION OF

STEEL WIRE BRUSHES

Made EXCLUSIVELY of ENGLISH Steel.

Write for Illustrated Catalogues to
THE NEW ANGLO-AMERICAN MACHINE BRUSH SYNDICATE,
31J, WOOL EXCHANGE, LONDON, E.C.
OR WIRE "LEMVILLE, LONDON."
TELEPHONE—
LONDON WALL
6835.

SAND MIXER.

Money to be got but he can't see it.

PATENT

MOULDING-SAND MIXING MACHINE.

Does **more and better work in one hour** than can be done by **two men in ten hours** in the ordinary way.

ADVANTAGES.

1.—Requires very small driving power.—One H.P. for 2 tons per hour.
2.—It accomplishes a great amount of work in a very short time.
3.—Durable. Repairs are hardly ever necessary.
4.—The outlay is insignificant in proportion to the results, and is soon recovered by the enormous saving in wages and better castings.

Ironfounders or their Managers invited to see the Machine at Work.

J. BAGSHAW & SONS, Ltd., BATLEY. YORKS., ENG.

New Centrifugal Sand Mixing Machine. . .

FOR MOULDING SAND.

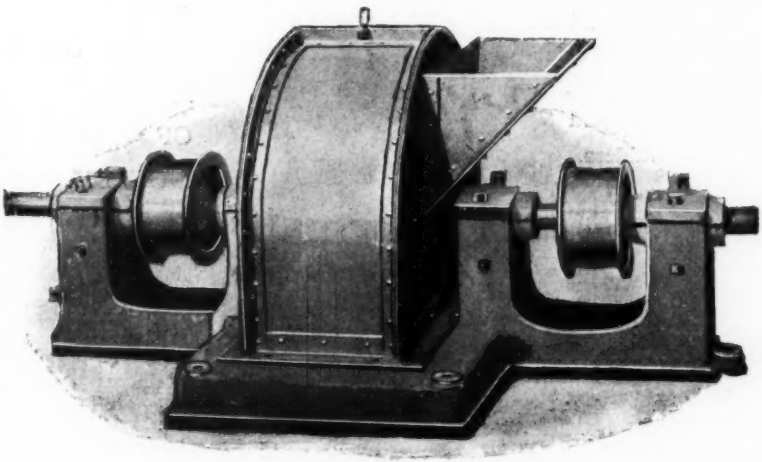


ILLUSTRATION OF NO. 1 SIZE.

This Machine has been recently improved and has a capacity of 5 tons per hour.

Both for the FINE QUALITY of sand and QUANTITY PRODUCED it is found they are preferred by moulders to the other types of mixing machines in use.

J. W. & C. J. PHILLIPS,

23, College Hill, LONDON, Eng.

TELEGRAMS "COLL OQUIAL, LONDON."

The McClelland Patent

SAND MOULDING MACHINE

Revolutionises Foundry Work by Simple and Direct Methods Satisfactory to both Employers and Moulders.

WILL SAVE FROM **70%** to **90%** IN COST OF MOULDING.

Type A.—Power Operated Carriage run under Rammer, Mould Rammed, Carriage Returned and Box Lifted, all Automatically. Arranged for one or two men to work continuously.

NO OTHER SAND MOULDING MACHINE HAS THE SPEED, SIMPLICITY AND STRENGTH OF THIS.

TURNS OUT BETTER MOULDS AND CASTINGS THAN BY HAND.

THE SAFETY TREAD SYNDICATE,

15, BARBICAN, LONDON, E.C.

Telephone, 5646 Bank. Telegraph, "Unslipping," London.

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FOUNDRY FOREMAN.—Wanted, thoroughly experienced FOREMAN for a Malleable Foundry in the Midlands; must be capable of producing by economical methods perfectly sound castings, both large and small, in malleable iron.—Address, giving full particulars of past career, age, references, and wages required, to "FOUNDRY," Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

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IRON WORKS MANAGER desires situation; practical man, experienced in sections, both iron and steel, and with coal and gas heating furnaces. References.—Address Box 244, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

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Foundry Core Oven,
Indispensable in any Foundry using small Cores.

Registered No. 356,812.
OVEN BUILT IN WALL.
4 Shelves, each 10 inches deep. Sizes: Front width, 3 ft. 6 in.; height, 4 ft. 8 in. Inside, width, 3 ft.; depth, 2 ft. 7 in.; height, 4 ft. 3 in.
Price, £12 10 0
CHARLES D. PHILLIPS,
Emlyn Iron Works, NEWPORT (Mon.).

FOR SALE AND WANTED.

FOR SALE, "Roots" Patent No. 5 Pressure Blower (Nearly New), 14¾ in. outlet, outside bearing and driving pulleys, all self contained, on heavy foundation plate bed; for 6 or 7 tons per hour. Photo sent on application. Lloyds' Patent Fan (as New), 8 in. outlet, at half-price.—Address J. LIGHT, Wolverhampton.

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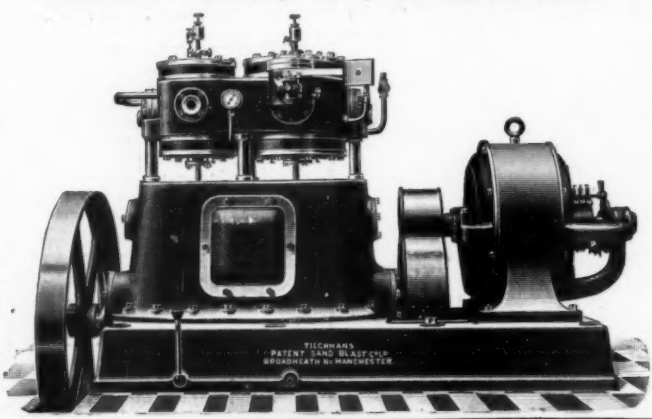

High efficiency, Silent working and 12 months guarantee.

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Tilghman's Patent Sand Blast Company, Ltd.,
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